United States Government Accountability Office

Report to the Ranking Member, Committee on Environment and Public Works, U.S. Senate

PEDESTRIAN SAFETY

NHTSA Needs to Decide Whether to Include Pedestrian Safety Tests in Its New Car Assessment Program

Accessible Version

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GAO-20-419

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GAO Highlights

Highlights of GAO-20-419, a report to the Ranking Member, Committee on Environment and Public Works, U.S. Senate

Why GAO Did This Study

In 2018, about 6,300 pedestrians—17 per day—died in collisions with motor vehicles in the United States, up from about 4,400 in 2008. Many factors influence pedestrian fatalities, including driver and pedestrian behavior. Vehicle characteristics are also a factor. NHTSA tests and rates new vehicles for safety and reports the results to the public through its NCAP. Currently, pedestrian safety tests are not included in NCAP.

This report examines: (1) what is known about the relationship between vehicle characteristics and pedestrian fatalities and injuries, (2) approaches automakers have taken to address pedestrian safety, and (3) actions NHTSA has taken to assess whether pedestrian safety tests should be included in NCAP. GAO analyzed data on pedestrian fatalities and injuries from 2008 through 2018 (the most recent available data); reviewed NHTSA reports; and interviewed NHTSA officials. GAO also obtained information about pedestrian safety features from 13 automakers that represented about 70 percent of new vehicle sales in the United States in 2018, and compared NHTSA's actions with leading program management practices.

What GAO Recommends

GAO is recommending that NHTSA (1) develop an evaluation plan with criteria for expanding its pilot program, (2) make and communicate a decision about whether to include pedestrian safety tests in NCAP, and (3) document the process for making changes to NCAP. The Department of Transportation concurred with our recommendations.

View GAO-20-419. For more information-contact Andrew Von Ah at (202) 512-2834 or VonAhA@gao.gov.

What GAO Found

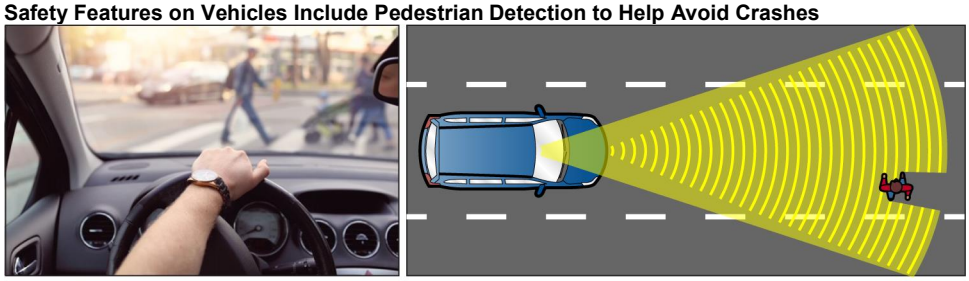
National Highway Traffic Safety Administration (NHTSA) data show that certain vehicle characteristics related to age, body type, and the speed of the vehicle at the time of the crash are associated with increases in pedestrian fatalities from 2008 to 2018. Specifically, the number of pedestrian fatalities during this time period increased more for crashes involving vehicles that were:

- 11 years old or older compared to newer vehicles,
- sport utility vehicles compared to other passenger vehicles, and
- traveling over 30 miles per hour compared to vehicles traveling at lower speeds.

GAO also found that NHTSA does not consistently collect detailed data on the type and severity of pedestrian injuries, but began a pilot program in 2018 to improve its data collection efforts. NHTSA, however, lacks an evaluation plan with criteria to assess whether to expand the pilot program, as called for in leading practices. As a result, NHTSA lacks information to determine how and whether it should expand the pilot to meet the agency's data needs.

Automakers offer a range of approaches to address pedestrian safety. For example, pedestrian crash avoidance technologies use cameras or radar to detect an imminent crash with a pedestrian and engage a vehicle's brakes to avoid a crash. GAO found that about 60 percent of the model year 2019 vehicles offered in the United States by 13 automakers had pedestrian crash avoidance technologies as standard or optional equipment.

Safety Features on Vehicles Include Pedestrian Detection to Help Avoid Crashes



Sources: National Highway Traffic Safety Administration (NHTSA) and GAO. | GAO-20-419

In 2015 NHTSA proposed pedestrian safety tests for its New Car Assessment Program (NCAP), but NHTSA has not decided whether it will include such tests in the program. NHTSA has reported that crash avoidance technologies could lead to a decrease in pedestrian fatalities. Nine automakers that GAO interviewed reported that NHTSA's lack of communication about pedestrian safety tests creates challenges for new product development. NHTSA has also not documented a clear process for updating NCAP with milestones for decisions. NHTSA officials said that updating NCAP involves many actions and can take years. However, absent a final decision on whether to include pedestrian safety tests in NCAP and a documented process for making such decisions, the public lacks clarity on NHTSA's efforts to address safety risks.

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Abbreviations

AAA	American Automobile Association
APA	Administrative Procedure Act

CIREN	Crash Injury Research and Engineering Network
DOT	Department of Transportation
CRSS	Crash Report Sampling System
Euro NCAP	European New Car Assessment Programme
FARS	Fatality Analysis Reporting System
FMVSS	federal motor vehicle safety standards
HLDI	Highway Loss Data Institute
IIHS	Insurance Institute for Highway Safety
JNCAP	Japan New Car Assessment Program
MPH	miles per hour
NASS/GES	National Automotive Sampling System/General Estimates System
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
NCAP	New Car Assessment Program
OMB	Office of Management and Budget
PAEB	pedestrian automatic emergency braking
SUV	sport utility vehicle
VIN	vehicle identification number

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

April 23, 2020

The Honorable Thomas R. Carper
Ranking Member
Committee on Environment and Public Works
United States Senate

Dear Senator Carper:

The number of pedestrians killed annually in motor vehicle crashes in the United States has increased from about 4,400 in 2008 to almost 6,300 in 2018—a roughly 43 percent increase. On average, 17 pedestrians a day died in motor vehicle crashes in 2018, up from 12 a day in 2008. At the same time, overall fatalities on the nation's roadways have generally been decreasing. Many factors can affect pedestrian fatalities and injuries, including driver and pedestrian behavior, distraction, and roadway and vehicle design. U.S. Department of Transportation (DOT) officials told us vehicle size class is also a contributing factor, and an increasing share of sport utility vehicles (SUVs) in the U.S. vehicle fleet may be responsible for some of the increases in pedestrian fatalities. For example, in May 2018 the Insurance Institute for Highway Safety (IIHS), an independent nonprofit scientific and educational organization sponsored by the auto insurance industry, reported that pedestrian fatalities associated with SUVs had increased substantially in recent years and that crashes are increasingly more likely to involve SUVs and higher horsepower vehicles.[1]

The National Highway Traffic Safety Administration (NHTSA) within DOT is the federal agency responsible for motor vehicle policy, regulation, and safety enforcement. The agency's mission is to save lives, prevent injuries, and reduce the economic costs associated with road traffic crashes; NHTSA seeks to accomplish this mission through education, research, safety standards, and enforcement activity. NHTSA's New Car Assessment Program (NCAP) provides consumers with comparative information on the safety of new vehicles to assist in vehicle purchasing

[1]Insurance Institute for Highway Safety, *Status Report: On Foot, At Risk*, Vol. 53, No. 3 (May 8, 2018). According to IIHS's Highway Loss Data Institute, an SUV is generally a vehicle built on a heavy duty chassis capable of off-road use, although they may be built on passenger car platforms.

decisions and NCAP encourages motor vehicle manufacturers to make vehicle safety improvements through testing and rating of new vehicles.

You asked that we review issues related to pedestrian safety and motor vehicles. This report: (1) Examines what is known about the relationship between motor vehicles' characteristics and pedestrian fatalities and injuries; (2) Describes approaches automakers have taken to address pedestrian safety and discusses stakeholder perspectives on these approaches; and (3) Evaluates actions NHTSA has taken to assess whether pedestrian safety testing should be incorporated into the NCAP.

To examine what is known about the relationship between motor vehicles' characteristics and pedestrian fatalities and injuries, we analyzed data from three NHTSA databases for the period of 2008 through 2018 (the most recent complete year of data at the time of our review). These include: (1) Fatality Analysis Reporting System (FARS); (2) Crash Report Sampling Systems (CRSS); and (3) National Automotive Sampling System/General Estimates System (NASS/GES). FARS data are derived from a census of fatal motor vehicle traffic crashes within the 50 states, Puerto Rico, and the District of Columbia. CRSS is a sample of police-reported motor vehicle crashes that involve all types of motor vehicles, pedestrians, and cyclists and that is used to develop national estimates of the number of injuries associated with motor vehicle crashes, among other things. NASS/GES preceded CRSS and similarly obtained its data from a nationally representative probability sample of police accident reports. Additional information about these databases is included in appendix I. We interviewed NHTSA officials about pedestrian safety data. We also interviewed selected academic researchers with expertise in human-vehicle interaction and selected automakers about pedestrian safety and data needs. We discuss the selection of automakers below. We reviewed documents related to a pilot program NHTSA recently initiated to assess data collection for pedestrian injuries and discussed this program with NHTSA officials. We assessed this program using criteria for designing successful pilot programs developed in prior GAO work.[2]

To describe how automakers are addressing pedestrian safety and to discuss stakeholder perspectives on these approaches, we obtained

[2]GAO, *Data Act: Section 5 Pilot Design Issues Need to Be Addressed to Meet Goal of Reducing Recipient Reporting Burden,* GAO-16-438 (Washington, D.C.: Apr. 19, 2016). This report identified five leading practices that, taken together, form a framework for effective pilot design. We evaluated NHTSA's pilot program against all five criteria.

information from 13 automakers that sold vehicles in the United States. The 13 automakers represented about 70 percent of new vehicles sold in the United States in 2018. We used a semi-structured interview format to obtain information from the 13 automakers about the pedestrian safety features included on their model year 2019 vehicles sold in the United States and the benefits and challenges of these features. We did not assess the effectiveness of these features. Results of these interviews are not generalizable to the universe of automakers that may sell vehicles in the United States. We also interviewed representatives of five companies identified by an auto industry trade association that supply pedestrian safety related equipment, as well as officials from auto industry trade associations, and NHTSA. Finally, we reviewed relevant federal motor vehicle regulations related to pedestrian safety.

To evaluate NHTSA's actions related to pedestrian safety and NCAP, we reviewed applicable federal laws and regulations, requests for comments published in the *Federal Register* on proposed NCAP changes,[3] and NHTSA NCAP program documents. We reviewed studies and presentations on NHTSA's work related to pedestrian safety, including potential pedestrian safety tests and their applicability to the U.S. vehicle fleet, the use of various test tools, and the potential safety effects associated with technologies intended to avoid crashes with pedestrians. We also visited NHTSA's Vehicle Research and Test Center in East Liberty, Ohio, and the IIHS Vehicle Research Center in Ruckersville, Virginia, and interviewed NHTSA and IIHS officials, respectively, at those locations. Further, we interviewed NHTSA officials about NHTSA's process for making changes to NCAP and communicating decisions to stakeholders. We also interviewed the automakers and auto industry equipment suppliers discussed above, and IIHS officials about incorporating pedestrian safety tests into NCAP. We evaluated NHTSA's process for deciding whether to make changes to NCAP using practices in the Project Management Institute, Inc., *The Standard for Program Management*, and GAO's *Standards for Internal Control in the Federal*

[3]According to NHTSA officials, although NCAP is not a regulation, NHTSA generally follows the processes in the Administrative Procedure Act for informal rulemaking to update NCAP through the notice, comment, and decision process in the *Federal Register* for transparency.

Government.[4] Appendix I provides a detailed discussion of our scope and methodology.

We conducted our work from February 2019 to April 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

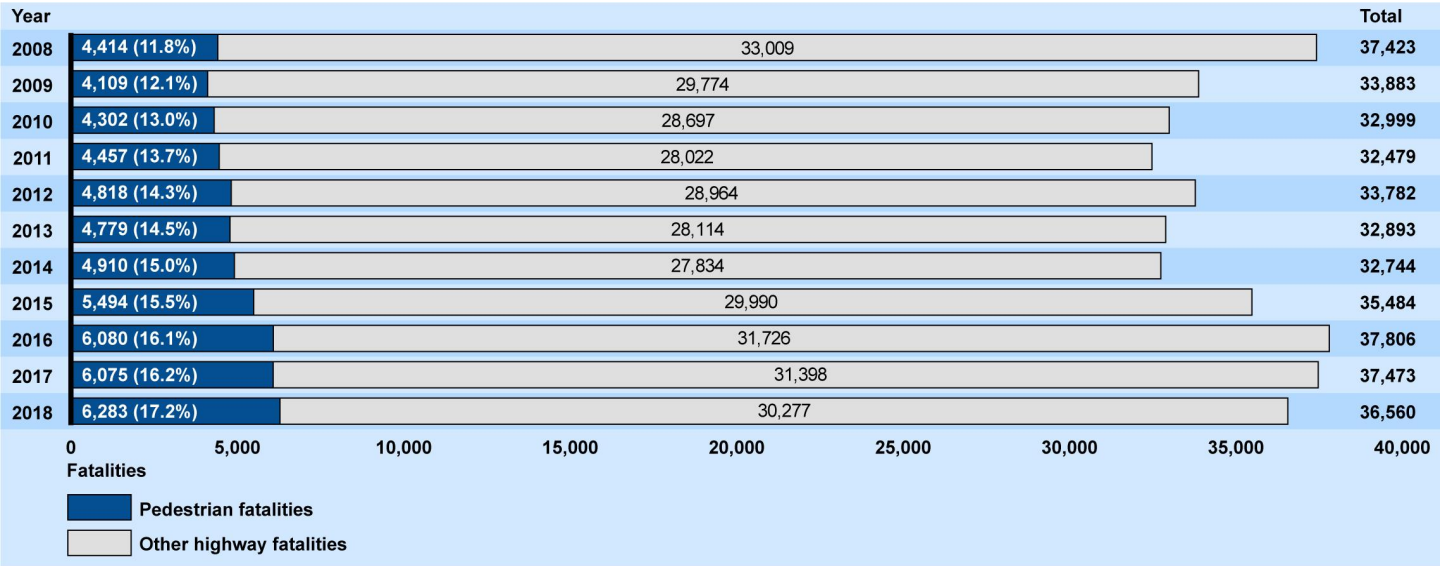
Background

Since 2008, both the number of pedestrian fatalities and the share of pedestrian fatalities as a percentage of overall highway fatalities have increased (see fig. 1). In 2008, pedestrian fatalities represented about 12 percent of overall highway fatalities, while in 2018 they represented about 17 percent. In addition to fatalities, the estimated number of pedestrians injured in crashes has increased from about 71,000 in 2008 to about 79,800 in 2018.[5]

[4]Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017) and GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 2014).

[5]The 95 percent confidence interval for the estimated number of pedestrians injured in crashes is (61,800, 80,300) in 2008 and (65,700, 93,900) in 2018. Additional information on the estimated number of pedestrians injured from 2008 through 2018 is in appendix II.

Figure 1: Total Highway and Pedestrian Fatalities and the Percentage of Pedestrian Fatalities to Total Highway Fatalities, 2008 through 2018



Source: GAO analysis of National Highway Transportation Safety Administration data. | GAO-20-419

A range of factors can influence pedestrian fatalities including exposure of pedestrians to crashes, roadway characteristics, and driver and pedestrian behavior. According to DOT officials, there is little nationwide information about pedestrian exposure to potential crashes and that data may be more available on the state or local level. Some national data, however, shows that there may have been some change in people walking. For example, the U.S. Census Bureau's American Community Survey estimated that in 2018, 4 million people reported walking to work compared with an estimated 3.8 million people in 2010.[6] Regarding roadways, in 2018 the National Transportation Safety Board (NTSB) reported that most pedestrian fatalities occur in urban areas on principal arterial roads that carry high volumes of traffic, traveling at the highest

[6]The 95 percent confidence interval for the 2018 estimate is (3,540,900, 4,498,800); and for 2010 is (3,377,500, 4,291,200). The American Community Survey collects information on social, economic, housing, and demographic characteristics of the nation's population. The number of people reported walking to work may be underestimated since the survey asks respondents to only choose the primary means of how they got to work in the previous week and does not include recreation or other trips. If a respondent used more than one means of transportation, they are to select the mode used for most of the distance and any walking they did would be unaccounted for.

speeds.[7] In 2015, we noted that behavior such as distracted driving, walking, and cycling may contribute to pedestrian and cyclist fatalities.[8] When drivers and pedestrians use cell phones or are otherwise distracted, they may be less aware of their surroundings and more likely to be involved in a crash.[9] Finally, NHTSA data shows that most pedestrian fatalities occurred after dark and at places other than intersections. Specifically, in 2018, of the 6,300 reported fatalities, over 4,700 pedestrians (about 75 percent) were killed after dark and about 4,600 pedestrians (about 73 percent) were killed at non-intersection locations. See appendix II for additional information on pedestrian fatalities from 2008 through 2018.

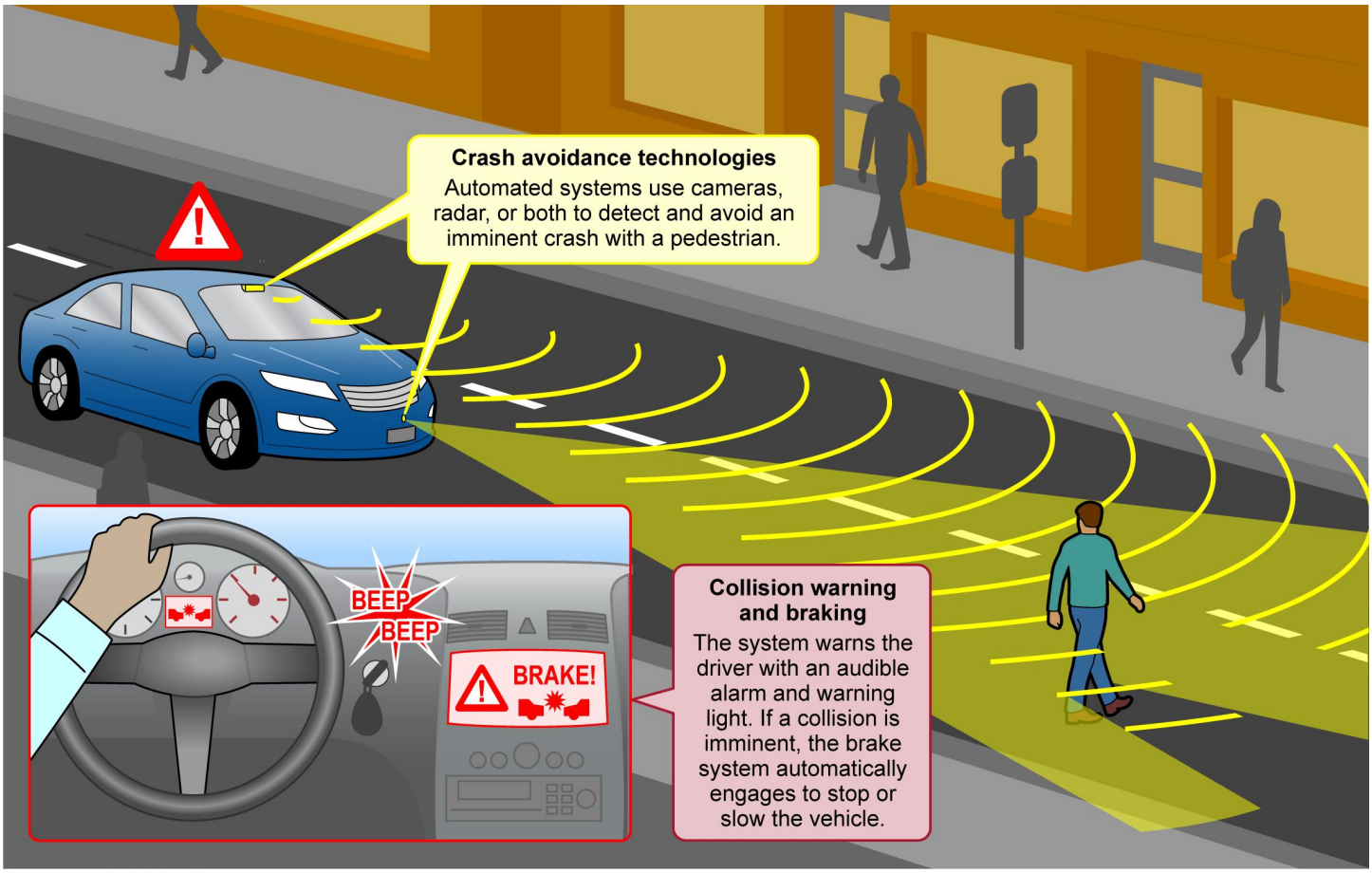
Automakers have developed vehicle features intended to avoid pedestrian crashes and mitigate the extent of injury to pedestrians. Crash avoidance features (also known as “active” safety features) rely on cameras, radar, and other devices to detect a pedestrian and then act to alert a driver to take action, or automatically apply a vehicle’s brakes to slow or stop the vehicle to avoid striking a pedestrian (see fig. 2). One pedestrian crash avoidance system is referred to as pedestrian automatic emergency braking, which uses a camera, radar, or a combination, to automatically apply brakes to avoid a collision.

[7]National Transportation Safety Board, *Special Investigation Report: Pedestrian Safety*, NTSB/SIR-18/03, PB2018-101632, Notation 58357 (Washington, D.C.: Adopted Sept. 25, 2018). The National Transportation Safety Board is an independent federal agency dedicated to promoting aviation, railroad, highway, marine, and pipeline safety.

[8]GAO, *Pedestrians and Cyclists: Cities, States, and DOT Are Implementing Actions to Improve Safety*, GAO-16-66 (Washington, D.C.: Nov. 19, 2015).

[9]We have recently initiated new work focused on the behaviors of various road users and their influence on pedestrian and cyclist safety that will look at some of these issues and plan to issue that work in 2021.

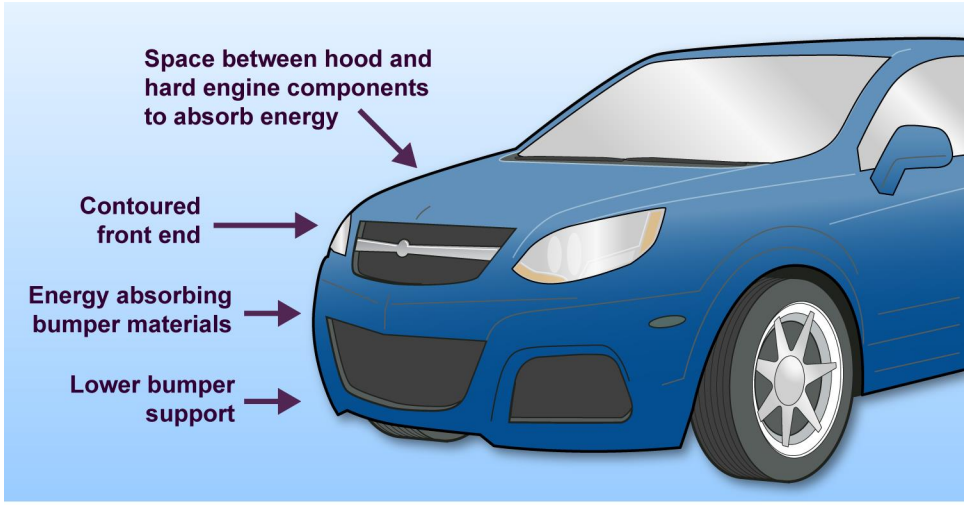
Figure 2: Example of a Pedestrian Crash Avoidance System



Source: GAO. | GAO-20-419

Crash mitigation features (also known as “passive” safety features) generally involve the use of pedestrian-friendly vehicle components that are designed to reduce the severity of injuries should a pedestrian be hit. Passive safety features can include energy absorbing bumper material, hoods that provide space between the hood and the hard components in the engine compartment, and contoured vehicle front-ends intended to reduce harm to pedestrians (see fig. 3).

Figure 3: Examples of Crash Mitigation Vehicle Components for Pedestrian Protection



Source: GAO. | GAO-20-419

In executing its mission, NHTSA administers NCAP and issues federal motor vehicle safety standards (FMVSS) and the federal bumper standard, among other things. In general, NCAP tests supplement safety standards established in law or regulation.

- **NCAP.** Created in 1978, this program tests new vehicles to determine how well they protect drivers and passengers during a crash (front and side) and how well vehicles resist rollovers. NHTSA tests and rates vehicles using a five-star safety rating system with five stars being the highest safety rating and one star the lowest. NHTSA communicates the results of its vehicle tests through window labels on new vehicles and on its website. In 2010, NHTSA also began recommending various safety technologies for consumers to consider when purchasing vehicles. Recommended technologies include such things as forward collision warning (an alert that warns drivers to brake or steer to avoid a crash if they are too close to a car in front of them); lane departure warning (an alert that warns drivers of unintentional lane shifts); and automatic emergency braking, which can automatically activate a vehicle's brakes if a driver takes no action to avoid an imminent crash with a preceding vehicle. NHTSA has not yet included pedestrian automatic emergency braking systems as recommended technologies. Recommended technologies are not included in star ratings, but rather are features NHTSA believes consumers may wish to look for in new vehicles. Pedestrian safety tests are not currently part of NCAP.

- **FMVSS.** These are minimum performance standards established in regulation for new motor vehicles and items of motor vehicle equipment. According to NHTSA officials, FMVSS have test procedures and performance criteria with minimum thresholds for motor vehicles and motor vehicle equipment, such as minimum light intensity requirements for headlamps.
- **Bumper standard**. In addition, while not in the FMVSS, NHTSA's bumper standard prescribes performance requirements in regulation for passenger cars in low-speed front-end and rear collisions.[10] According to NHTSA officials, the bumper standard is intended to prevent damage to the car body and safety related equipment at speeds equivalent to a 5 miles-per-hour (mph) crash into a parked vehicle of the same weight. The standard applies to front and rear bumpers on passenger cars, but not to other multipurpose passenger vehicles, such as SUVs, minivans, or pickup trucks.[11]

The United States is also involved with pedestrian safety internationally. In June 1998, the United States signed an international agreement administered by the United Nations concerning the establishment of global technical regulations for motor and other wheeled vehicles.[12] The purpose of the agreement was to establish a global process for jointly developing technical regulations regarding such things as safety, environmental protection, and energy efficiency of vehicles. As part of this agreement, in 2008, Global Technical Regulation No. 9 was established to improve pedestrian safety by requiring vehicle hoods and bumpers to absorb energy more efficiently when impacted in a vehicle-to-pedestrian collision.[13] This international standard has two sets of performance criteria: head impact requirements that ensure vehicle hoods provide protection to a pedestrian's head when impacted; and leg protection requirements for the front bumper that would require bumpers to subject pedestrians to lower impact forces. According to NHTSA, as a signatory

[10]49 C.F.R. Part 581. According to NHTSA, the bumper standard applies to front and rear bumpers on passenger cars to prevent damage to the car body and safety related equipment at a barrier impact speed of 2.5 miles per hour across the full width of the bumper and 1.0 mph at the corners.

[11]49 C.F.R. § 581.3.

[12]United Nations Economic Commission for Europe, *Agreement Concerning the Establishment of Global Technical Regulations for Wheeled Vehicles, Equipment and Parts Which Can Be Fitted and/or Be Used on Such Wheeled Vehicles* (June 1998).

[13]United Nations Economic Commission for Europe, Global Technical Regulation Number 9, *Pedestrian Safety*, ECE/TRANS/180/Add.9 (Nov. 12, 2008).

to the 1998 agreement, the United States is obligated to consider adopting global technical regulations, but is not obligated to adopt them. NHTSA officials told us the agency has not yet initiated the rulemaking process for Global Technical Regulation No. 9.[14]

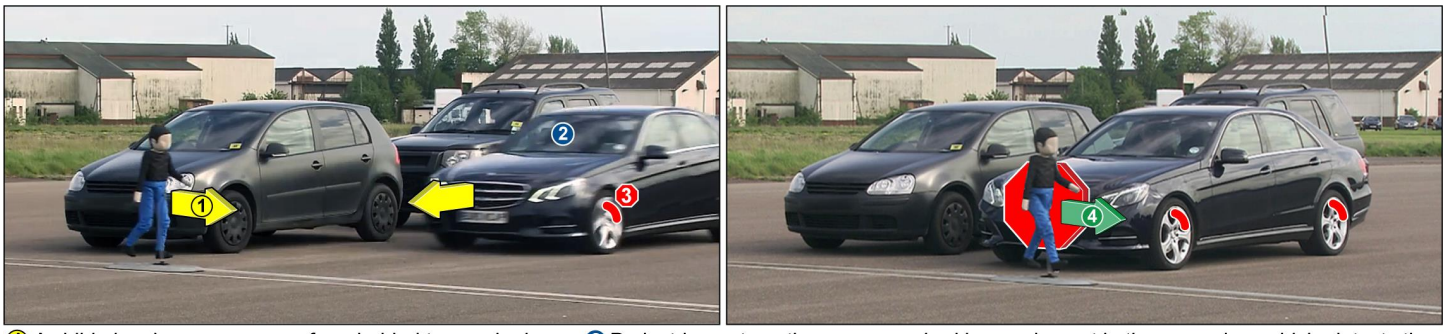
Although pedestrian safety testing is not currently a part of the U.S. NCAP, it is a part of similarly established new car assessment programs in other countries. For example, since 2016 both the European New Car Assessment Programme (Euro NCAP) and a program in Japan (known as the Japan New Car Assessment Program (JNCAP)) have tested vehicle pedestrian crash avoidance systems using a variety of scenarios and vehicle speeds.[15] Euro NCAP tests include an adult dummy walking or running perpendicular to a test vehicle and walking parallel to a vehicle. Tests are also conducted with a child dummy running out from parked cars (see fig. 4). Euro NCAP tests are also conducted in daylight and at night. In the United States, two nongovernmental organizations have also conducted pedestrian safety testing. IIHS began a program to test pedestrian crash avoidance systems on 2018 and 2019 vehicles, and in 2020 began using the results to help determine its Top Safety Pick awards. The American Automobile Association (AAA) also recently conducted tests of crash avoidance systems.[16]

[14]65 Fed. Reg. 44565 (July 18, 2000).

[15]Similar to the U.S., both Europe and Japan use a star rating system to indicate test results, with five stars being the highest and one star the lowest. Stars are determined based on points earned on test results.

[16]AAA is a not-for-profit organization that offers its members with travel, insurance, financial, and automotive services and information. It also advocates for the safety of travelers.

Figure 4: Pedestrian Crash Avoidance Test with Child Running Out From Parked Cars

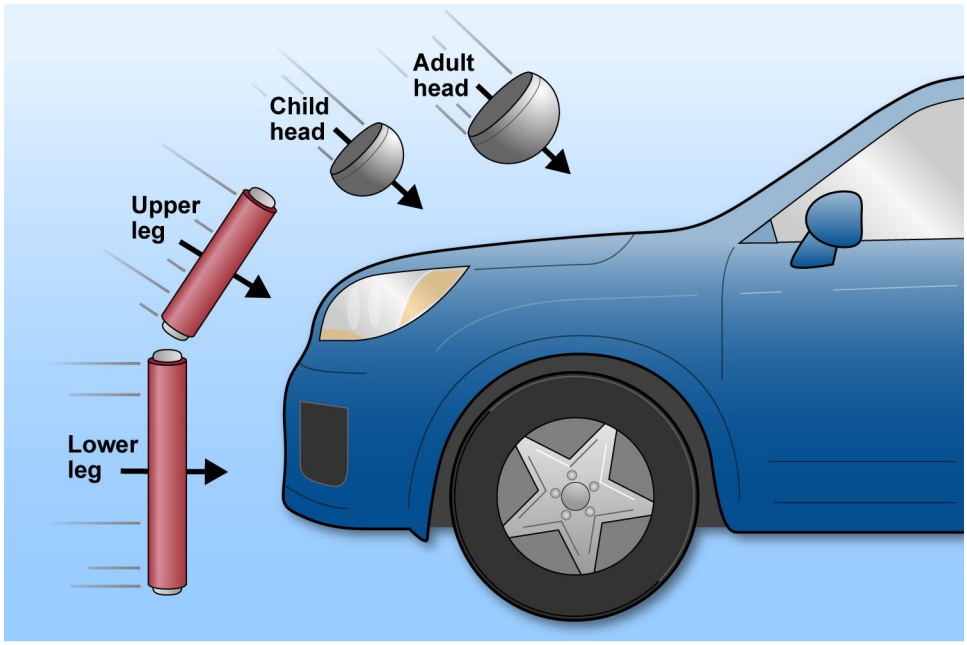


1 A child-size dummy emerges from behind two parked cars. 2 Pedestrian automatic emergency braking equipment in the oncoming vehicle detects the dummy and 3 automatically engages the brake system. 4 The vehicle comes to a stop and the dummy continues along its path unharmed.

Source: European New Car Assessment Programme (Euro NCAP) and GAO. | GAO-20-419

Moreover, crash mitigation tests that measure the potential for head and leg injuries resulting from pedestrian-motor vehicle crashes have been in place for many years in Europe and Japan. Euro NCAP began head and leg testing in 1997 and Japan began pedestrian head protection testing in 2003 and pedestrian leg protection testing in 2011. In general, these tests launch projectiles designed to simulate a person's legs or head into various locations on a vehicle's hood and bumper to assess the effectiveness in limiting pedestrian injury (see fig. 5).

Figure 5: Illustration of Crash Mitigation Tests Designed to Measure Potential Head and Leg Injuries



Source: GAO. | GAO-20-419

Vehicle Age, Body Type, and Speed Are Associated with Pedestrian Fatalities, But Gaps Remain in NHTSA's Pedestrian Injury Data

We found that several vehicle characteristics including the age and body type of the vehicle and the speed at which the vehicle was being driven at the time of the crash are associated with the increase in pedestrian fatalities from 2008 through 2018. However, NHTSA lacks complete data on the relationship between vehicle characteristics and pedestrian injuries, including detailed information on injury type and severity. Although NHTSA initiated a pilot program to improve its data collection protocol for pedestrian injuries, NHTSA lacks a plan for this program to evaluate its results and determine whether and how it should be expanded.

The Number of Reported Pedestrian Fatalities Increased for Crashes Involving Older Vehicles, SUVs, and Vehicles Traveling at Higher Speeds

Through FARS, NHTSA annually collects and analyzes data on all crashes involving pedestrian fatalities, including vehicle-related characteristics. Based on these data and relevant research, we analyzed the relationship between pedestrian fatalities and the age, body type, and speed of vehicles.[17] Our analysis of FARS data shows that from 2008 through 2018, the number of pedestrian fatalities increased more for crashes involving vehicles that were:

- 11 years old or older (123 percent increase) compared with newer vehicles (9 percent increase);
- SUVs (68 percent increase) compared with other light trucks (25 percent increase), and passenger cars (47 percent increase); and
- traveling at reported speeds 31 mph and above (45 percent increase), compared to vehicles traveling at lower speeds (28 percent increase).[18]

Vehicle Age

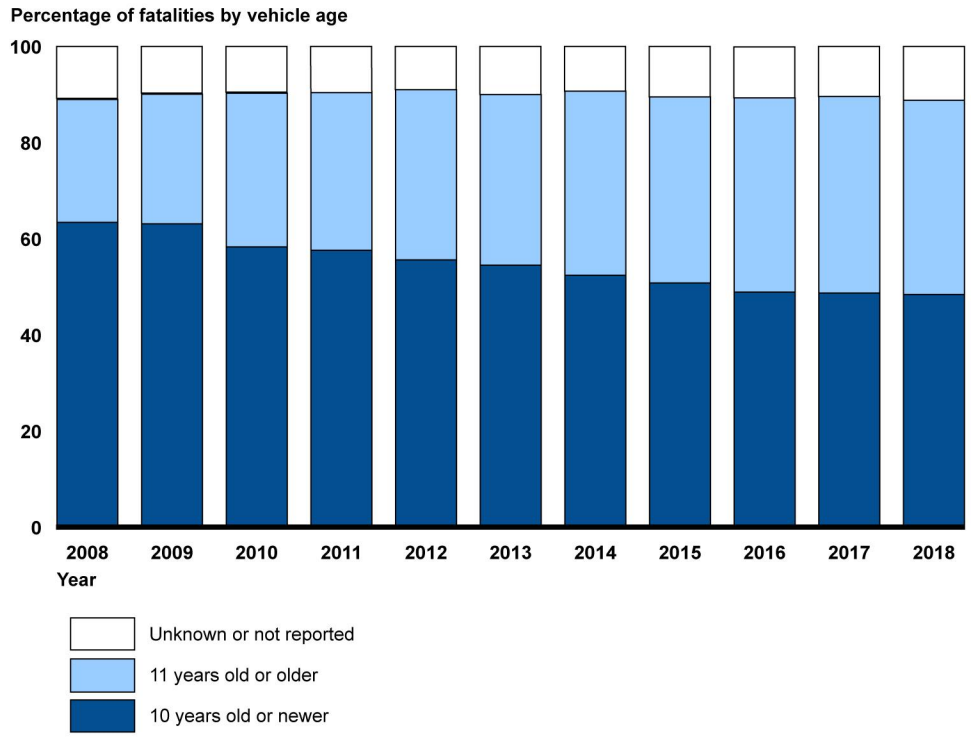
The number of pedestrians struck and killed by vehicles 11 years old or older (older vehicles) increased more relative to the number of pedestrians struck and killed by vehicles 10 years old or newer (newer vehicles). In 2008, 1,139 pedestrian fatalities involved older vehicles, which represented about a quarter (26 percent) of reported pedestrian fatalities (see fig. 6). By 2018, that number more than doubled to 2,537 pedestrian fatalities, or 40 percent of reported pedestrian fatalities. Over that same time period, the number of pedestrian fatalities involving newer vehicles also increased from 2,800 in 2008 to 3,044 in 2018. However, this increase was less than fatalities involving older vehicles, and the

[17]Due to the numerous potential factors involved in motor vehicle crashes, these data cannot be used to determine the cause of a particular crash or fully explain the rise in pedestrian fatalities since 2008. Our analysis looked at bivariate relationships between the number of fatalities and vehicle characteristics. We did not examine which of these factors or combination of factors contributed most to the rise in pedestrian fatalities.

[18]Although we recognize that speed can reflect driver's behavior (e.g. was the driver exceeding the posted speed limit), we considered speed a physical characteristic of the vehicle at the time of the crash since speed could influence the severity of pedestrian injuries.

overall share of pedestrian fatalities involving newer vehicles decreased from 63 to 48 percent over that period.

Figure 6: Percentage of Pedestrian Fatalities by the Age of Vehicle That Struck the Pedestrian, 2008 through 2018



Source: GAO analysis of National Highway Traffic Safety Administration Fatality Analysis Reporting System data. | GAO-20-419

The rise in the number of older vehicles involved in pedestrian fatalities may reflect the rise in the average age of vehicles in operation.[19] According to data from DOT's Bureau of Transportation Statistics,[20] the average age of all vehicles in operation in the United States increased by about 1.5 years from 10.1 years old in 2008 to 11.7 years old in 2018. In comparison, the average age of passenger vehicles that struck and killed pedestrians increased by roughly 2 years from 8.1 years in 2008 to 10 years in 2018. Another possible contributing factor to the increased share of pedestrian fatalities resulting from crashes with older vehicles may be the prevalence of safety features in newer vehicles compared with older

[19]The term "vehicles in operation" refers to passenger cars, light trucks, SUVs, and vans.

[20]The Bureau of Transportation Statistics within DOT provides statistics on transportation economics to decision makers and the public.

vehicles. As discussed below, vehicle manufacturers are offering new vehicles with pedestrian safety features such as pedestrian crash avoidance and crash mitigation systems, which may reduce pedestrian injuries and fatalities.

Vehicle Body Type

The number of pedestrian fatalities where passenger cars, SUVs, or other light trucks were reported as striking vehicles all increased from 2008 to 2018 (see table 1). However, the number of SUVs involved in fatal pedestrian crashes increased by a higher percentage than passenger cars and other light trucks. As table 1 shows, pedestrian fatalities involving SUVs increased by about 68 percent, while pedestrian fatalities involving passenger cars increased by 47 percent and light trucks and vans increased by 25 percent. Additionally, although the number of SUVs involved in pedestrian fatalities increased the most in this timeframe, passenger cars still accounted for the largest share of fatalities.

Table 1: Number of Pedestrian Fatalities by Body Type of the Vehicle That Struck the Pedestrian, 2008 through 2018

Year	Passenger cars[a]	Sport utility vehicles (SUV)[b]	Light trucks and vans[c]
2008	1,800	729	1,075
2009	1,693	683	1,066
2010	1,757	740	1,083
2011	1,859	752	1,072
2012	2,090	815	1,140
2013	1,962	811	1,161
2014	2,055	850	1,227
2015	2,383	955	1,252
2016	2,573	1,149	1,400
2017	2,557	1,223	1,331
2018	2,651	1,222	1,346
Total 2008 through 2018	**23,380**	**9,929**	**13,153**
Total Percentage of Passenger Vehicle Fatalities 2008 through 2018	50.3	21.4	28.3
Percentage Change in Fatalities from 2008 to 2018	47.3	67.6	25.2

Source: GAO Analysis of National Highway Transportation Safety Administration Fatality Analysis Reporting System Data. | GAO-20-419

[a]For our analysis, we used NHTSA's classifications for vehicle body types. NHTSA considers passenger cars as light vehicles such as sedans, hatchbacks, coupes, and convertibles that are designed primarily to transport eight or fewer persons.

[b]NHTSA considers SUVs or utility vehicles as multipurpose vehicles with increased ground clearance and strong frames, which are generally designed for carrying persons and off-road capabilities.

[c]NHTSA considers light trucks and vans as including light conventional trucks, such as pickup trucks and other vehicles designed with small passenger cabs, large hoods, and an open cargo area, or van-based light trucks, such as minivans and other vehicles designed to maximize enclosed cargo and passenger areas, and other light trucks, which are based on conventional light pickup frames, but may include commercial or recreational vehicle body features

Data on the growth of SUVs within the U.S. vehicle fleet and academic research identify potential contributing factors as to why the number of SUVs involved in pedestrian fatalities increased between 2008 and 2018:

- **Increasing SUV market share**. SUVs represent a growing share of the total U.S. vehicle fleet. According to the Highway Loss Data Institute,[21] the share of new vehicles in the United States that were SUVs grew from 30 percent in model year 2008 to 48 percent in model year 2018. In addition, 11 of the 13 auto manufacturers we interviewed stated that SUV sales, either market-wide or at their company, increased relative to passenger car sales in the United States since 2008.
- **Increased risk of injuries based on vehicle size and weight**. Research suggests that if a pedestrian is struck by a vehicle with greater mass the crash is more likely to result in serious injuries or a fatality than if the pedestrian is struck by a lower-mass vehicle. For example, one study we reviewed that cited work from five other studies found that the chief determinants for the severity of injuries in motor vehicle collisions are vehicle size and weight.[22] According to one NHTSA-funded study,[23] which used information from NHTSA's Pedestrian Crash Data Study,[24] researchers found that the probability of death for pedestrians struck by light trucks (including SUVs) was 3.4 times higher than for pedestrians struck by passenger cars.

[21]The Highway Loss Data Institute supports IIHS by studying insurance claim data, collected from IIHS member organizations, to understand the human and economic losses resulting from the ownership and operation of different types of vehicles.

[22] E. Desapriya, S. Subzwari, D. Sasges, A. Basic, A. Alidina, K. Turcotte, and I. Pike "Do Light Truck Vehicles (LTV) Impose Greater Risk of Pedestrian Injury Than Passenger Cars? A Meta-analysis and Systematic Review," *Traffic Injury Prevention,* vol. 11, no. 1, (2010): pp 48-56.

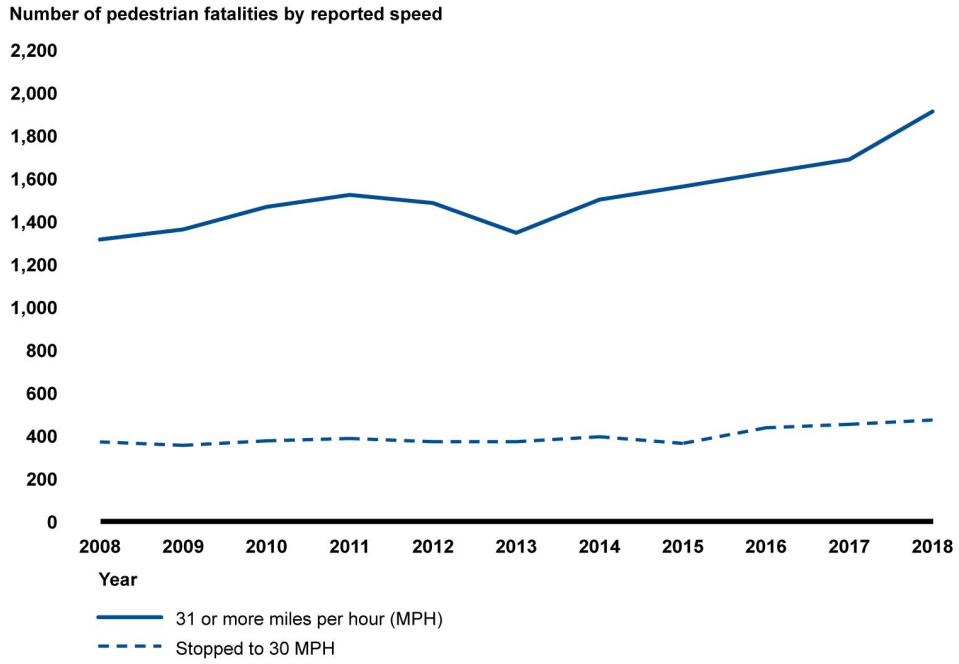
[23]B. S. Roudsari, C. N. Mock, R. Kaufman, D. Grossman, B. Y. Henary, J. Crandal, "Pedestrian Crashes: Higher Injury Severity and Mortality Rate for Light Truck Vehicles Compared with Passenger Vehicles." *Injury Prevention,* 2004, vol. 10: pg. 154-158.

[24]This study was conducted by NHTSA between 1994 and 1998 to collect detailed pedestrian crash data based on reconstructions of crashes.

Vehicle Speed

Between 2008 and 2018, the number of pedestrian fatalities involving higher speeds (31 mph and above) at the time of the crash increased more sharply than the number involving lower speeds (30 mph and below). Although vehicle speed was missing or not reported for 62 percent of pedestrian fatalities (as discussed below), our analysis of FARS data showed that when speed data are recorded, the number of pedestrian fatalities involving vehicles reportedly travelling at higher speeds increased from 1,315 to 1,912 (45 percent) between 2008 and 2018 (see fig. 7). The number of pedestrian fatalities involving vehicles reportedly traveling at lower speeds also increased, but at a smaller percentage (28 percent) than vehicles at higher-speed. During this time period, about 79 percent of pedestrian fatalities involved vehicles travelling 31 mph and above, and about 21 percent involved vehicles traveling at lower speeds.

Figure 7: Number of Pedestrian Fatalities by the Reported Speed of Vehicle That Struck the Pedestrian, 2008 through 2018



Source: GAO analysis of National Highway Traffic Safety Administration Fatality Analysis Reporting System data. | GAO-20-419

Note: Fatal pedestrian crashes where speed was missing or not reported are not shown in this figure.

Multiple studies have found that when vehicles travel at higher speeds and strike pedestrians, they are more likely to kill or severely injure the

pedestrian. For example, the NTSB reported in 2018 that the relationship between speed and the severity of injuries is consistent and direct—higher crash speeds result in injuries that are more severe.[25] The NTSB added that the effect of speed is especially critical for pedestrians because they lack protection. In addition, according to a 2019 report from the National Cooperative Highway Research Program, a pedestrian's risk of fatality is 90 percent when struck by vehicles travelling between 54 and 63 mph compared with a 10 percent risk of fatality between 24 and 33 mph.[26]

We also found that between 2008 and 2018, the speed of the striking vehicle was not reported for about 62 percent of pedestrian fatalities. This omission is likely because it is difficult for police officers to determine a vehicle's speed after a crash occurs. Further, some organizations we spoke with told us that low speed collisions were typically underreported. According to NHTSA officials, the speed recorded is generally up to the discretion of the responding police officer.

NHTSA Lacks Complete Data on the Relationship between Vehicle Characteristics and Pedestrian Injuries

NHTSA officials and other stakeholders we interviewed identified limitations in NHTSA's data on the relationship between vehicle characteristics and pedestrian injuries. These include (1) incomplete and inconsistent injury designations, (2) crash and vehicle information not linked to medical data, and (3) outdated pedestrian crash investigation data.

- **Incomplete and inconsistent injury information.** Within CRSS, NHTSA relies on information provided in police reports to determine national estimates of injured pedestrians.[27] According to NHTSA officials, data from the police reports are typically after-the-fact descriptions of

[25]National Transportation Safety Board, *Special Investigation Report*: *Pedestrian Safety.*

[26]The National Academies of Sciences, Engineering, and Medicine. *Pedestrian Safety Relative to Traffic-Speed Management* (Washington, DC: The National Academies Press, 2019).

[27]NHTSA officials noted there are other datasets, including the Crash Investigation Sampling System and National Automotive Sampling System/Crashworthiness Data System that include pedestrian injury information. However, the officials agreed these investigation-based datasets are primarily focused on vehicle occupants, not pedestrians.

events and NHTSA conducts little, or no, follow up investigations of these reports. As a result, CRSS data may not include the cause of crashes or pedestrian injuries, and for some crashes it may be missing detailed information on specific characteristics of the striking vehicle. In addition, there may be inconsistencies in pedestrian injury information.[28] NHTSA's injury severity data rely on reporting from states and localities, which may define injury severity differently, year-to-year. As we have reported, NHTSA standardized the injury severity definitions nationally in April 2019; however, it will take time for states to adopt this standard.[29]

- **Crash and vehicle data are not linked to medical records**. According to NTSB and some researchers we spoke with, the five point injury severity scale used on police crash reports does not effectively capture injury severity or actual injury outcomes because NHTSA does not link crash data with medical and hospital records.[30] Without crash and vehicle information linked to medical records, researchers cannot crosscheck injury severity designations with actual injury outcomes or identify specific injury types. NHTSA previously sponsored a program to help link crash data with injury data contained in medical records, but federal funding for the program was discontinued in 2013.[31]
- **Outdated pedestrian crash investigation data**. NHTSA last collected detailed data on pedestrian crash and injury characteristics from 1994 to 1998. The Pedestrian Crash Data Study collected information from over 500 pedestrian crashes, including data on pedestrian injury types, severity, and potential causation. The study also reported the vehicle's type and the part of the vehicle that caused the injury, such as the front bumper. In its 2018 report, NTSB stated that while this study was the most complete set of pedestrian crash data available in the United States, the data are over 20 years old. NTSB recommended that NHTSA develop a detailed and current pedestrian crash data set for local and state analysis and to model and simulate pedestrian collision avoidance

[28]Police use a 5-point scale, known as the KABCO scale, to designate injuries. These include fatal (K), serious (A) minor (B), possible (C), or no injury (O).

[29]GAO, *Traffic Safety: Improved Reporting Could Clarify States' Achievement of Fatality and Injury Targets*, GAO-20-53 (Washington, D.C.: Oct. 22, 2019).

[30]National Transportation Safety Board, *Special Investigation Report: Pedestrian Safety*.

[31]This program, known as the Crash Outcome Data Evaluation System, was a state-based program sponsored by NHTSA from 1992 to 2013 that used a statistical linkage process to combine information from crash reports, hospital records, and other sources to better improve the completeness and accuracy of motor vehicle crash information, as well as analyze crashes, injury diagnoses, and severity.

systems. As of February 2020, however, NHTSA had not fully implemented the recommendation. Some automakers and equipment suppliers we spoke with noted that improved real world injury data would help them better develop pedestrian safety features.

NHTSA has recognized that it needs to collect more detailed and complete data on pedestrian injuries. For example, in a 2011 report to Congress on the agency's data gaps, NHTSA noted that internal stakeholders (those within NHTSA) requested an updated Pedestrian Crash Data Study with crashes involving late-model-year vehicles and detailed injury data on the body region impacted rather than the vehicle's point of contact.[32] Further, in its 2016 to 2020 strategic plan, NHTSA stated that it would work to improve the quality, timeliness and relevance of safety data collected.[33]

NHTSA Has Begun a Pilot Program to Improve Its Data Collection Protocol for Pedestrian Injuries, but Lacks a Plan to Evaluate Results

In 2018, NHTSA initiated a pilot program to evaluate existing and new protocols for collecting pedestrian crash and injury data as part of its Crash Injury Research and Engineering Network (CIREN).[34] The purpose of this pilot program is to develop a data collection protocol and collect preliminary data for pedestrian-motor vehicle crashes, including analysis on injury causation. Further, NHTSA stated that it intends to use this protocol and data as the foundation for subsequent pedestrian crash studies such as research related to injury trends and testing tools. NHTSA officials also told us that the pilot will help update and build upon the data collection and analysis protocols for pedestrian-motor vehicle crashes used in the 1990s in the Pedestrian Crash Data Study. According

[32]U.S. Department of Transportation, National Highway Traffic Safety Administration, Report to Congress: *NHTSA's NASS Data Needs August 2011,* DOT HS 811 889. (February 2014).

[33]U.S. Department of Transportation, National Highway Traffic Safety Administration, "*The Road Ahead: National Highway Traffic Safety Administration Strategic Plan 2016 – 2020*, DOT HS 812 343 (October 2016).

[34]According to NHTSA, the CIREN process combines prospective data collection with professional multidisciplinary analysis of medical and engineering evidence to help determine injury causation in crash investigations. NHTSA first established CIREN in 1997. The CIREN program primarily focuses on vehicle occupant injuries and is a more in-depth evaluation of crashes than FARS or CRSS.

to NHTSA officials, the pilot will collect data on nine cases from two hospitals. A third hospital will provide engineering support. NHTSA officials stated that they limited the pilot study to nine cases so they would be able to act quickly on the pilot to determine if a full project was worth pursuing and to avoid delays.[35] According to NHTSA officials, they expect initial results to be available by fall 2020.

We have reported that a well-developed and documented pilot program can help ensure that agency assessments produce information needed to make effective program and policy decisions.[36] Well-designed pilot programs use five leading practices including:

1. establishing clear, appropriate, and measurable objectives;
2. articulating an assessment methodology and data gathering strategy;
3. developing a data analysis and evaluation plan to track pilot performance and implementation;
4. identifying criteria for determining whether and how to scale the pilot and integrate it into overall efforts; and
5. ensuring two-way stakeholder communication through the pilot program.

Through our review of the CIREN pedestrian pilot program documentation, we determined that NHTSA met most of the criteria for a well-developed pilot program, but not all. Specifically, NHTSA documented clear, appropriate, and measureable project objectives; identified an assessment methodology and data gathering strategy; developed a data analysis plan; and communicated with stakeholders. NHTSA, however, did not establish an evaluation plan that includes criteria to determine if the pilot program's data collection and analysis protocol should or could be continued or expanded, once the data have been collected from the nine cases. Although NHTSA officials reported that they had a plan to review and evaluate individual cases, NHTSA does not have an evaluation plan for the pilot program that includes criteria or standards for identifying lessons learned or determining

[35]NHTSA officials told us that, pursuant to the Paperwork Reduction Act of 1995, the agency must undergo a lengthy process to obtain Office of Management and Budget (OMB) approval when interviewing or collecting information from the public for any more than nine cases. See 44 U.S.C. § 3507.

[36]GAO-16-438.

whether the new data collection and analysis procedures would satisfy data needs related to pedestrian's injuries.

NHTSA officials told us that they did not develop an evaluation plan or criteria for determining the success or scalability of the pedestrian pilot program because they were not required to create one.[37] They also said they did not have enough information to tell if the pilot program should be integrated into overall efforts, although they expect the tools developed by the pilot to be incorporated into later efforts to increase the number of pedestrian crashes reviewed under the CIREN program.

Without a documented evaluation plan that includes criteria for determining whether and how to scale the pilot program, NHTSA will lack the necessary information to determine if the program should be expanded to include more cases or whether expanding the program will fill its current data gaps and future data needs related to pedestrian injuries and vehicle characteristics. An evaluation plan could help NHTSA ensure that the data collected fulfills the goal of the pilot program, which is to build a foundation for subsequent research on pedestrian injury trends, potential causation, and vehicle design

[37]According to NHTSA officials, there is no documented NHTSA or DOT guidance on creating pilot programs or on how they are to be structured.

Automakers Reported That Various Pedestrian Safety Features Are Commonly Available in New Vehicle Models and That All Features Have Benefits and Challenges

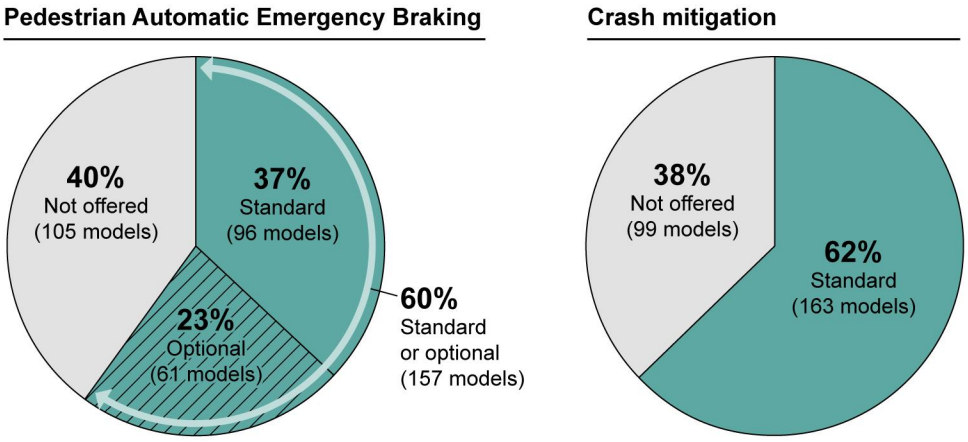
Most Automakers Reported Offering Pedestrian Crash Avoidance or Mitigation Safety Features

Pedestrian crash avoidance and crash mitigation safety features are commonly available on many 2019 model year vehicles offered in the United States, according to the 13 automakers we interviewed. As previously discussed, crash avoidance features rely on cameras or radar or both to detect a pedestrian and take action to avoid a crash. Crash mitigation generally involves use of pedestrian-friendly vehicle components (such as energy absorbing bumper components or hoods) that are designed to reduce the severity of injuries should a pedestrian be hit.

The 13 automakers we interviewed responded that they, collectively, offered 262 model year 2019 vehicles for sale in the United States. Of those vehicle models, almost 60 percent included pedestrian automatic emergency braking as either a standard or an optional feature (see fig. 8). About 62 percent of their model year 2019 vehicles had some type of standard pedestrian crash mitigation feature.[38] In total, 12 of 13 automakers that we interviewed responded that they offered one or more 2019 model year vehicles with pedestrian automatic emergency braking as either a standard or optional feature; similarly, 12 of 13 automakers told us they offered crash mitigation features in at least one of their 2019 model year vehicles.

[38]In 2019, the 13 automakers that we interviewed reported vehicles with crash mitigation features as either standard or not available, as these features were not offered as optional equipment.

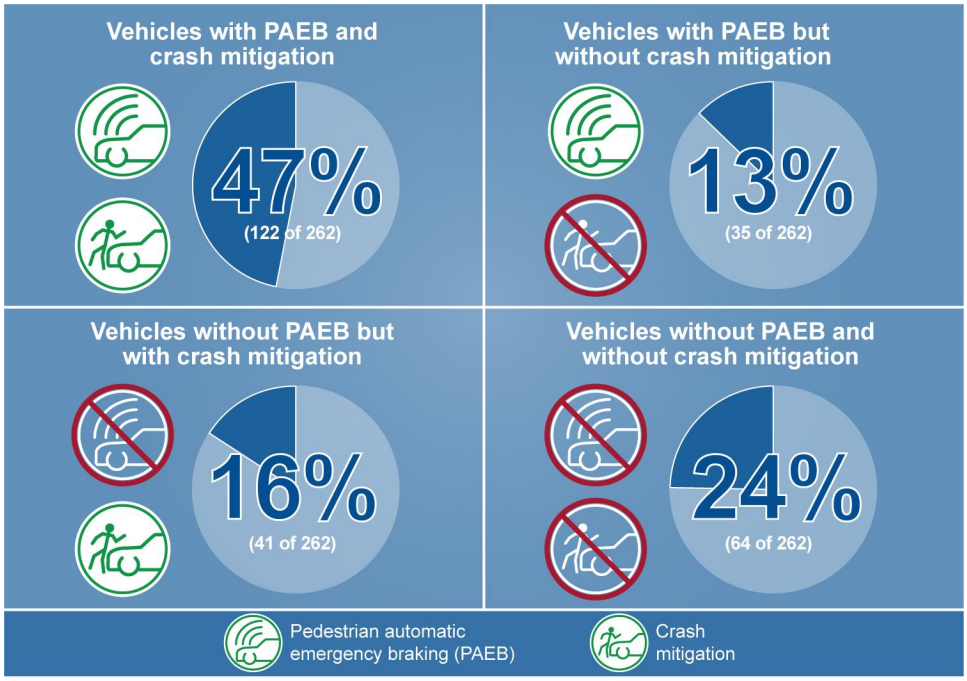
Figure 8: Model Year 2019 Vehicles Offering Pedestrian Automatic Emergency Braking or Crash Mitigation Features, as Reported by 13 Automakers



Source: GAO analysis of automaker interview responses. | GAO-20-419

Some stakeholders we interviewed told us that a combination of crash avoidance and crash mitigation features can be effective in minimizing pedestrian injury. For example, NHTSA officials told us that crash avoidance features, such as pedestrian automatic emergency braking can slow a vehicle to a speed where it will be less damaging to a pedestrian once struck, and if the vehicle also has crash mitigation features the impact of the crash can be further mitigated. We found that almost half of 2019 vehicle models had some combination of both pedestrian automatic emergency braking and crash mitigation features. For example, about 47 percent of 2019 vehicle models had pedestrian automatic emergency braking as either standard or optional equipment along with crash mitigation features, such as softer hoods. However, 24 percent of vehicle models had neither of these (see fig. 9).

Figure 9: Model Year 2019 Vehicles Offering Combinations of Pedestrian Automatic Emergency Braking (PAEB) and Crash Mitigation Features, as Reported by 13 Automakers



Source: GAO analysis of automaker interview responses. | GAO-20-419

Officials from the 13 automakers we interviewed identified a variety of factors that influenced their decisions to offer vehicles with pedestrian safety features in the United States. These include a desire to achieve high safety ratings for their vehicles, as well as the following:

- **New car assessment programs**: New car assessment programs in the United States and other countries also influence why automakers may offer pedestrian safety features. For example, officials from nine of 10 automakers that responded to this question in our interview replied that Euro NCAP was a major factor to them in providing pedestrian safety features, while seven of 10 automakers responded that JNCAP was a major factor.[39] In contrast, three of 11 automakers responded that the U.S. NCAP was a major factor in their decisions to offer vehicles with pedestrian safety features. As previously discussed, the United States,

[39]Not all 13 automakers addressed all of our interview questions. When there were fewer than 13 respondents, we identify the total number of automakers that responded to that particular question. For additional information on our methodology, see appendix 1.

unlike the European Union and Japan, does not incorporate pedestrian safety tests into its NCAP.

- **Independent safety testing**: Independent safety testing was also a factor in why automakers may offer pedestrian safety features on vehicles. For example, officials from five automakers said that they considered IIHS safety ratings to be a major factor in their company's decision to offer pedestrian safety features on vehicles sold in the United States.[40] As previously discussed, IIHS began testing pedestrian crash avoidance systems on 2018 and 2019 vehicles. These tests are known as pedestrian automatic emergency braking tests and in 2020 IIHS began using the results to help determine their Top Safety Pick awards. Officials from two automakers said a company's goal is to earn an IIHS top safety-pick rating for each of their models.
- **Cost**: Cost appeared to be less of a factor influencing whether pedestrian safety features were offered on vehicles. Officials from seven of eight automakers who responded to this question replied that costs either were a minor factor, or did not apply, in their decisions to offer vehicles with pedestrian safety features. However, officials from four automakers told us that, in general, while customers want safer vehicles, automakers have to consider what safety features could be included without increasing the overall cost. Further, one automaker's representative said that as more manufacturers and customers are buying crash avoidance systems the costs are decreasing.

The future availability of crash avoidance features may depend on several factors. Specifically, in 2016, 20 automakers voluntarily committed to making automatic emergency braking systems standard in vehicles sold in the United States by 2022. Officials from three automakers said that they planned to incorporate pedestrian automatic emergency braking into their vehicles' automatic emergency braking systems as part of this commitment.

Another factor is customer demand. One automaker said that the number of models that include pedestrian safety features in the future would depend on consumer demand or changes in regulation. Officials from another automaker said their customers often ask for features they see in Europe and ask why such features are available there but not in the United States.

[40]Automakers voluntarily provided this response during our interviews. We did not identify IIHS as a factor that automakers could identify as a factor in providing pedestrian safety features in our initial interviews.

Auto Industry Officials Cited Various Benefits and Challenges of Commonly Available Pedestrian Safety Features

The auto industry officials we interviewed identified benefits and challenges with commonly available pedestrian safety features. Benefits of crash avoidance systems include the potential of eliminating or reducing car-to-pedestrian accidents. For example, officials from six automakers said that crash avoidance features were more effective than crash mitigation features because the purpose of crash avoidance features is to prevent the collision from occurring in the first place. Almost half of the automakers we interviewed (six of 13), however, reported that a primary challenge with a camera-based pedestrian automatic emergency braking system was the camera's ability to work in low lighting or poor weather. Recently issued research has raised questions about the overall effectiveness of crash avoidance systems. In October 2019, AAA reported that based on its own assessment, some vehicles' pedestrian safety systems were inconsistent at either slowing down or stopping a vehicle to avoid hitting a pedestrian.[41] Specifically, the association reported that none of the crash avoidance systems on the four vehicles they tested worked in dark conditions.

Auto industry officials also identified benefits and challenges with pedestrian crash mitigation features. For example, 12 of 13 automakers reported that crash mitigation features have the overall benefit of reducing the risk or severity of pedestrian injuries. Officials from eight automakers, however, said that the current federal bumper standard created challenges to offering softer, more pedestrian-friendly bumpers in the United States.[42] Officials from the eight automakers said they offered softer bumpers in Europe or elsewhere—where there is no similar bumper standard—but do not offer softer bumpers in the United States. NHTSA officials told us the current bumper standard is primarily a cost savings standard in that it is intended to reduce repair costs and not necessarily to offer safety protection for vehicle occupants. NHTSA officials told us trade-offs are required to establish a bumper standard that addresses pedestrian safety, yet minimizes bumper damage and repair

[41]American Automobile Association, Inc. *Automatic Emergency Braking with Pedestrian Detection.* (October 2019).

[42]As previously discussed, NHTSA officials said that the federal bumper standard is intended to prevent damage to the car body and safety equipment at speeds equivalent to a 5 mph crash into a parked vehicle of the same weight.

costs. NHTSA officials told us they are in the process of reevaluating the bumper damageability standard, as part of a Notice of Proposed Rulemaking, which they expect to publish in 2020.

Appendix III discusses the benefits and challenges of commonly available pedestrian safety features.

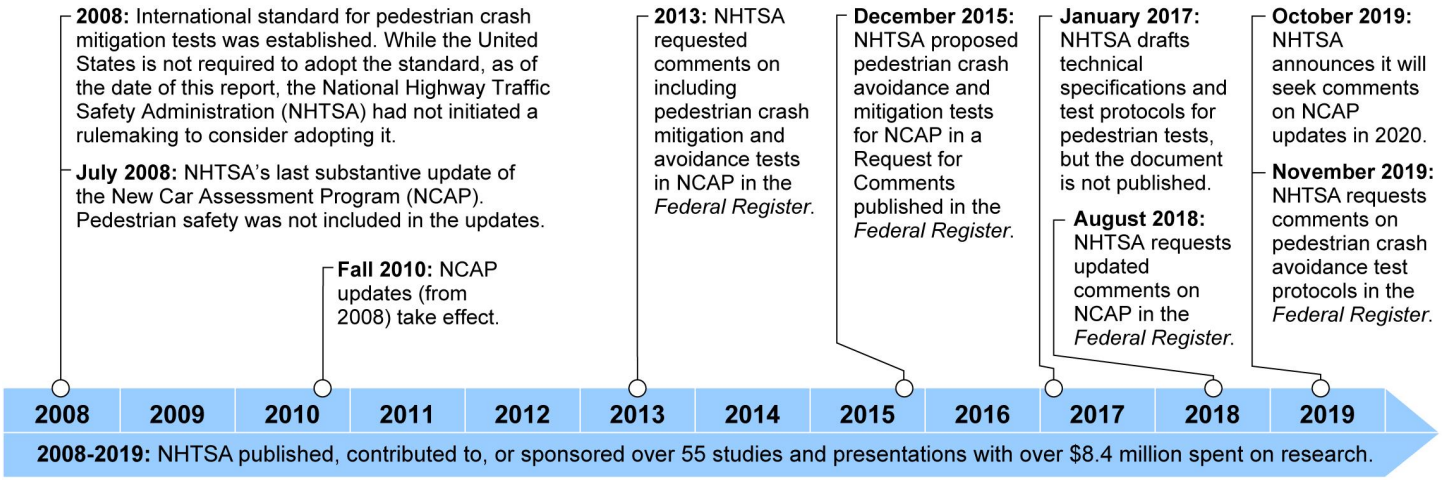
NHTSA Has Proposed Pedestrian Safety Tests for NCAP, but Lacks a Clear Process for Updating the Program and Has Yet to Make or Communicate a Decision

NHTSA Has Conducted Research and Proposed Pedestrian Safety Tests over the Last 10 Years

NHTSA has considered pedestrian safety for many years by conducting research, considering implementation of global regulations for pedestrian crash mitigation tests, and proposing pedestrian crash avoidance and mitigation tests for NCAP (see fig. 10). NHTSA's last substantial update of NCAP was in July 2008 (with changes effective for model year 2011 vehicles). This update established additional crash tests and technical standards to protect vehicle occupants, but did not include pedestrian safety tests.[43]

[43]In the July 2008 Final Decision notice published in the *Federal Register* (73 Fed. Reg. 40016 (July 11, 2008)), NHTSA made several changes to NCAP, including making frontal and side crash ratings criteria more stringent by upgrading crash test dummies, establishing new injury criteria, adding a new side pole crash test, and creating a single overall vehicle score that reflects a vehicle's combined frontal crash, side crash, and rollover ratings.

Figure 10: Timeline of Selected NHTSA Actions Related to Pedestrian Safety Tests Since 2008



Source: GAO. | GAO-20-419

Since NCAP Was Last Updated, NHTSA Contributed to Developing Global Pedestrian Regulations and Conducted Research

In the past 10 years, NHTSA has considered but has not yet initiated a rulemaking process related to international standards for crash mitigation tests, among other actions. For example, in 2008, the United States along with other countries approved a United Nation's international standard for pedestrian crash mitigation tests.[44] This international standard, if implemented in the United States in a domestic regulation, would require U.S. vehicles to meet minimum performance requirements in pedestrian crash mitigation tests. The United States approved the international standard in 2008; however, NHTSA has yet to initiate a rulemaking to implement it either as part of the FMVSS or adopt it as a testing protocol through NCAP. According to NHTSA officials, implementation of the standard would require NHTSA to initiate a regulatory proceeding. Although the United States formally agreed to the standard more than 10 years ago, NHTSA officials told us that the rulemaking initiative is

[44]In an effort to harmonize vehicle safety standards globally, the United Nations created the Economic Commission for Europe 1998 Global Agreement that the U.S. signed. In 2008, parties to the 1998 agreement agreed to Global Technical Regulation No. 9, which specifies pedestrian crash mitigation test protocols and minimum performance requirements with the intention of reducing the levels of injuries sustained by pedestrians involved in frontal impacts with motor vehicles.

classified as a long-term action and that there is no timeline for such a rulemaking to implement pedestrian crash mitigation requirements.[45]

NHTSA has also conducted a range of research on pedestrian crash avoidance and mitigation tests. Specifically, NHTSA has published, contributed to, or sponsored over 55 studies and presentations on pedestrian safety issues since 2008, and NHTSA officials provided information stating that NHTSA has spent over $8.4 million to research pedestrian safety, including pedestrian automatic emergency braking and passive safety features from 2008 through 2019. In addition, officials stated that NHTSA has conducted a number of additional studies related to pedestrian safety, studies that NHTSA is currently reviewing for final publication, though officials did not provide expected publication dates. NHTSA officials told us this research serves as a body of work that supports and facilitates agency decisions and policies with respect to pedestrian safety.

NHTSA's pedestrian safety research has focused on several key issues, including developing objective test protocols and reliable test instruments for inclusion in NCAP and assessing the potential safety benefits. NHTSA officials told us there are three important elements associated with any safety tests (including pedestrian safety tests). These elements are (1) creating test protocols that measure a vehicle's safety performance objectively, (2) validating test instruments that measure human injury, and (3) estimating the potential safety benefit of the tests. NHTSA's pedestrian safety research includes work related to all three of these elements, as follows:

- **Objective Test Protocols**. One NHTSA study developed objective test protocols to evaluate the effectiveness of pedestrian crash avoidance systems based on analyses of crash scenarios from real-world crash data.[46] Another NHTSA study applied pedestrian crash mitigation test protocols used by Euro NCAP to the U.S. vehicle fleet. NHTSA found that

[45]As discussed earlier, the 1998 agreement under which global technical regulations are approved generally obligates contracting parties to consider adopting the global technical regulations within their own jurisdictions, but does not obligate them to adopt them. 65 Fed. Reg. 44565 (July 18, 2000).

[46]M. Carpenter, T. Moury, J. Skvarce, M. Struck, T. Zwicky, and S. Kiger, U.S. Department of Transportation, National Highway Traffic Safety Administration, *Objective tests for forward looking pedestrian crash avoidance/mitigation systems, Final report*, Report No. DOT HS 812 040 (Washington, D.C.: June 2014).

the European protocols could be used to assess the pedestrian safety performance of vehicles in the United States, but that the performance of different U.S. vehicle types could vary. Specifically, NHTSA found that "global platform" vehicles (i.e., models that include a U.S. and European variant of the same vehicle) offered more pedestrian safety than vehicles that are only marketed in the United States.[47]

- **Valid Test Instruments**. NHTSA has been a key contributor in the development of pedestrian test instruments. For example, NHTSA has presented information on mannequins for evaluating the repeatability and accuracy of pedestrian crash avoidance systems, concluding that mannequins should be durable, realistic, and comparable in size and movement to humans.[48] In addition, NHTSA found there are instruments that produce repeatable and reproducible measurements of pedestrian head, upper leg, and lower leg injuries on tests.[49]
- **Potential Safety Benefits**. NHTSA has studied the potential benefits of pedestrian crash avoidance, and estimated that these technologies could reduce the number of annual vehicle-pedestrian crashes by between 620 and 5,000, and reduce the number of annual fatal vehicle-pedestrian

[47]In that report, NHTSA tested a sample of nine vehicles (four passenger cars, three SUVs, one minivan, and one pick-up truck) using Euro NCAP crash mitigation tests. The study offered reasons for the better performance of global platform vehicles compared to U.S. only vehicles: 1) global platforms may have been constructed to conform with pedestrian safety standards in Europe that the U.S. does not have, and 2) U.S. market vehicles tend to be larger than global vehicles, with higher front-ends that have a propensity to perform poorly in leg tests. B. Suntay, J. Stammen, and P. Martin, U.S. Department of Transportation, National Highway Traffic Safety Administration, *Pedestrian Protection – Assessment of the U.S. Vehicle Fleet*, Report No. DOT HS 812 723 (Washington, D.C.: June 2019).

[48]H. Albrecht, "Pedestrian Test Mannequins Objective Criteria for Evaluating Repeatability and Accuracy of PCAM Systems" (PowerPoint presentation, SAE Active Safety Symposium, Plymouth, MI, National Highway Traffic Safety Administration: Nov. 5, 2015).

[49]B. Suntay, and J. Stammen, U.S. Department of Transportation, National Highway Traffic Safety Administration, *Vehicle Hood Testing To Evaluate Pedestrian Headform Reproducibility, GTR No. 9 Test Procedural Issues, and U.S. Fleet Performance,* Report No. Docket # NHTSA-2008-0145-0014 (Washington, D.C.: August 2018). Also, see B. Suntay, and J. Stammen, U.S. Department of Transportation, National Highway Traffic Safety Administration, *Technical Evaluation of the TRL Pedestrian Upper Legform,* Report No. DOT HS 812 659 (Washington, D.C.: May 2019). Also see B. Suntay and J. Stammen, U.S. Department of Transportation, National Highway Traffic Safety Administration, *Technical Evaluation of the Flexible Pedestrian Leg Impactor (Flex-PLI),* Report No. NHTSA-2008-0145 (Washington, D.C, May 2014).

crashes by between 110 and 810.[50] NHTSA has also reported that Europe and Japan have responded to the high proportion of pedestrian fatalities compared to all traffic fatalities by including pedestrian protection in their respective NCAPs and requiring pedestrian protection through regulation.[51] According to NHTSA, these actions have likely contributed to a downward trend in pedestrian fatalities in Europe and Japan.

Further, an international study found that including pedestrian safety testing in consumer testing programs has real world benefits by reducing pedestrian fatalities and injuries. For example, a European study concluded that vehicles that score well in Euro NCAP pedestrian crash mitigation tests are less likely to severely injure pedestrians.[52] As previously noted, Euro NCAP and JNCAP have included pedestrian crash mitigation tests since 1997 and 2003, respectively, and both Euro NCAP and JNCAP incorporated pedestrian crash avoidance tests in 2016.

NHTSA Proposed Pedestrian Safety Tests in 2015 and Has Since Requested Comments

In December 2015, NHTSA proposed pedestrian crash avoidance and mitigation safety tests for NCAP by publishing a Request for Comments notice in the *Federal Register*.[53] In the 2015 Request for Comments, NHTSA indicated that including these tests in NCAP could lead to a decrease in vehicle-pedestrian crashes and resulting pedestrian injuries and fatalities. In this request, NHTSA also reported that it believed the greatest gains in highway safety in coming years would result from widespread application of crash avoidance technologies and that its proposed safety tests for crash avoidance technologies, including

[50]M. Yanagisawa, E. Swanson, P. Azeredo, & W. Najm, U.S., Department of Transportation, National Highway Traffic Safety Administration, *Estimation of Potential Safety Benefits for Pedestrian Crash Avoidance/Mitigation Systems,* Report No. DOT HS 812 400 (Washington, D.C.: April 2017).

[51]80 Fed. Reg. 78522 (Dec. 16, 2015).

[52]C. Pastor, ‘‘Correlation Between Pedestrian Injury Severity in Real-life Crashes and Euro NCAP Pedestrian Test Results’’ (Paper No. 13-0308, 23rd International Technical Conference on the Enhanced Safety of Vehicles, Seoul, Korea, May 2013).

[53]80 Fed. Reg. 241, 78522 (Dec. 16, 2015). NHTSA issued its 2015 Request for Comments subsequent to a 2013 notice in which NHTSA first requested comments on including pedestrian crash mitigation and avoidance testing in NCAP, among other potential changes. 78 Fed Reg. 20597 (Apr. 5, 2013).

pedestrian detection and automatic emergency braking, met NHTSA's four prerequisites for updating NCAP. Those four prerequisites include that:

- a safety need is known or capable of being estimated;
- vehicle and equipment designs exist (or are anticipated in prototype design) that are capable of mitigating the safety need;
- a safety benefit is estimated based on the anticipated performance of the existing or prototype design; and
- a performance-based, objective test procedure exists to measure the ability of the vehicle technology to mitigate the safety issue.[54]

With regard to crash mitigation tests, NHTSA reported that it intended to use the Euro NCAP test procedures rather than those used in Japan because the European fleet make-up, including vehicle sizes and classes, is more similar to the U.S. fleet.[55] NHTSA also reported in its 2015 Request for Comments that including pedestrian crash mitigation tests in NCAP is necessary to stimulate improvements in pedestrian crashworthiness in new vehicles sold in the United States. NHTSA, however, did not state in its 2015 Request for Comments whether the proposed crash mitigation tests met NHTSA's prerequisites for updating NCAP, as it had for the crash avoidance tests. The proposed changes in the 2015 Request for Comment were to take effect for model year 2019 vehicles.

In response to the 2015 Request for Comment, NHTSA officials told us they received 290 comments, 31 of which addressed pedestrian safety. According to the officials, the comments received were generally supportive of including pedestrian safety testing in NCAP, and commenters proposed that the U.S. tests should be consistent, or harmonized, with the tests already conducted by Euro NCAP. NHTSA officials also noted that some commenters expressed concern with test tools and proposed test scenarios.

Since the 2015 proposal to include pedestrian tests in NCAP, NHTSA has continued to solicit updated information in additional Requests for

[54]80 Fed. Reg. 78522, 78548 (Dec. 16, 2015). According to the Request for Comments, NHTSA may weight some of these criteria differently for some features than for others, if NHTSA believes it is in the interest of developing a robust program that encourages safety advancements in the marketplace not among those listed above.

[55]80 Fed. Reg. 78522, 78548.

Comments. Most recently, in October 2019 NHTSA announced it would seek comment on NCAP updates in 2020, and in November 2019, NHTSA requested comments on draft research test procedures for forward and rear pedestrian crash avoidance, among other technologies. However, NHTSA stated that its draft test procedures were developed for research purposes only, and the fact that it was soliciting comments on these procedures was not an indication that it would then, or at any time in the future, initiate a rulemaking related to that technology or include that technology in NCAP.

NHTSA Lacks a Clear Process for Updating NCAP and Has Not Made or Communicated a Decision for Including Pedestrian Safety in NCAP to Stakeholders

Process for Updating NCAP

NHTSA officials told us there are many actions that go into their decision-making on whether to update NCAP and that this decision-making process can take years. These actions include such things as reviewing data, ensuring the reliability and repeatability of proposed tests by validating protocols at multiple independent test laboratories, and conducting market research to obtain consumer input.[56] In addition, NHTSA officials told us that it also uses its four prerequisites for updating NCAP, and while these prerequisites are not required by law, they represent good governance practices and are in consumers' best interest. However, since NCAP is considered a consumer testing information program and not a regulation, there are no particular requirements for when or how final decisions would be made as to whether pedestrian safety should or should not be included in NCAP. NHTSA officials told us that ultimately the NHTSA Administrator decides whether to go forward with changes to NCAP.

Although NHTSA officials told us NCAP is not a regulation, they said NHTSA generally follows the processes in the Administrative Procedure Act for informal rulemaking to update NCAP. This process includes a notice, comment, and decision process in the *Federal Register* for

[56]NHTSA officials told us that consumer testing is an extensive process that often requires OMB approval in order to conduct focus groups with more than nine participants, per the Paperwork Reduction Act and OMB implementing regulations.

transparency.[57] NHTSA, however, has not used this process to communicate to stakeholders the additional steps that it must take before it can make its decision on NCAP testing. In addition, although NHTSA requested and received numerous comments on including pedestrian safety tests in NCAP in 2015, as of April 2020, it has yet to respond to those comments.

Leading practices for program management emphasize the importance of milestones and decision points, documentation, and clearly communicating to external stakeholders. The Project Management Institute, Inc., *The Standard for Program Management* stresses the importance of program management plans that align with organizational goals and objectives. Elements of such plans are to provide a roadmap that identifies such things as milestones and decision points to guide programs forward.[58] In addition, *Standards for Internal Control in the Federal Government*, state that entities should externally communicate the necessary quality information to achieve the entity's objectives. In particular, entities should communicate to external stakeholders significant matters related to risks or changes. These standards also state that documentation is necessary for design, implementation, and operating effectiveness.[59]

Compared to these leading practices, NHTSA's process does not provide documentation of the process, decision points, or milestones to guide the program. For example, NHTSA officials could not provide us with documentation as to how it determined that the pedestrian crash

[57]The Administrative Procedure Act (APA) governs the process by which many federal agencies develop and issue regulations. In the context of informal rulemaking, the act generally requires agencies to publish a Notice of Proposed Rulemaking in the *Federal Register* and provide interested persons (commenters) an opportunity to comment on the proposed rule. Pub. L No. 79-404, 60 Stat. 237 (1946) (APA rule making provisions are codified as amended at 5 U.S.C. § 553). Agencies must consider any significant comments submitted during the comment period when drafting the final rule. This process provides, among other things, the public an opportunity to present information to agencies on the potential effects of a rule, or to suggest alternatives. NHTSA uses this process to update NCAP, but is not required to do so because NCAP is a voluntary consumer information program, according to NHTSA officials. In contrast, NCAP's safety rating information is required by statute to be a part of the Monroney label (i.e., new car sticker where star ratings are published) for which NHTSA is statutorily required to issue regulations implicating the act's rulemaking requirements.

[58]Project Management Institute, Inc.,*The Standard for Program Management* Fourth Edition*,* 2017.

[59]GAO-14-704G.

avoidance tests proposed in 2015 met the four prerequisites, or how the proposed crash mitigation tests compared to the prerequisites. Other NCAPs have used various methods for documenting their process for updating their testing. For example, Euro NCAP uses a roadmap to communicate to stakeholders the planned changes for NCAP tests, the timeline of steps toward the changes, and when those changes will be effective.[60] Officials from Euro NCAP told us the test and assessment protocols are developed in conjunction with working groups made up of automakers, equipment suppliers, test facilities, and Euro NCAP member organizations. Further, officials told us the working groups and roadmaps provide automakers with the opportunity to provide real-time input and obtain information to support their investment decisions.

The lack of a documented overall process for updating NCAP affects NHTSA's ability to achieve NCAP's goals to provide manufacturers an incentive to improve the safety performance of new vehicles and to assist consumers with their vehicle purchasing decisions. Specifically, without a transparent process for NHTSA's decision-making on NCAP, automakers lack information on NHTSA's progress in evaluating proposed changes—such as those offered in the 2015 Request for Comment—and the timing of the implementation of any specific testing procedures. This is particularly important because automakers need quality information to make investments to support the development and deployment of new technologies and equipment in their product lines to meet testing requirements. For example, representatives from one automaker told us that vehicle design is a 6 to 8 year product cycle and that if NHTSA decides to implement certain tests in the middle of that cycle, it would be difficult and costly to make changes. Without a clearly documented process for making changes to NCAP, including established criteria and milestones for decisions, automakers and the public lack clarity on NHTSA's plans for improving vehicle safety to inform investment and purchasing decisions.

Decision on Pedestrian Safety Testing in NCAP

NHTSA has yet to make or communicate a decision as to whether it intends to include pedestrian safety tests in NCAP. As discussed above, NHTSA has conducted extensive research and requested comments on pedestrian crash avoidance and mitigation tests in 2013 and 2015.

[60]Euro NCAP officials told us roadmaps are published every 5 years and include changes to testing procedures, which occur on a bi-annual basis.

Although NHTSA reported in 2015 that these tests could lead to a decrease in vehicle-pedestrian crashes and resulting pedestrian injuries and fatalities, it has yet to make or communicate a decision about the future of NCAP in relation to pedestrian safety to stakeholders. Nine of 13 automakers we interviewed told us that a lack of communication from NHTSA on its plan for addressing pedestrian safety issues has presented a challenge to them, often because they require long lead times to develop, test, and launch new technologies.

Leading practices for program management also stress the importance of communication with stakeholders and that effective stakeholder communications are key to executing program endeavors, addressing risks, and, ultimately, delivering benefits. Specifically:

- The Project Management Institute, Inc., *The Standard for Program Management* stresses the importance of managing external communications, stating that communication provides critical links for successful decision making.[61] It also stresses the importance of providing decision-making stakeholders with adequate information to make the right decisions at the right time in order to move programs forward.
- *Standards for Internal Control in the Federal Government* states that entities should identify, analyze, and respond to risks related to achieving the defined objectives and should externally communicate the necessary quality information to achieve the entity's objectives.[62] As discussed above, these standards also state that management should externally communicate quality information to external stakeholders significant matters related to risks or changes.

Further, the statute underlying NCAP requires NHTSA to communicate certain vehicle safety information to the public.[63] Specifically, DOT is to provide the public with information on crash avoidance, crashworthiness, and damage susceptibility.[64] Such information is to be provided in a

[61]Project Management Institute, Inc., *The Standard for Program Management,* Fourth Edition, 2017.

[62]GAO-14-704G.

[63]The Motor Vehicle Information and Cost Savings Act in 1972, as amended and recodified, requires the Secretary of Transportation to provide the public with information on certain passenger motor vehicle characteristics including crash avoidance, crashworthiness, and damage susceptibility. 49 U.S.C. § 32302(b).

[64]49 U.S.C. § 32302(b).

simple and understandable form to allow comparison among vehicles to assist a consumer in buying a new car.[65]

NHTSA officials told us that it has not made or communicated a decision as to whether it will include pedestrian safety testing in NCAP because administration priorities have shifted since publication of the 2015 Request for Comments. Specifically, NHTSA officials told us that the agency drafted technical specifications and testing protocols for pedestrian safety tests for NCAP and posted those tests to its public web site in January 2017. After the administration changed, however, those specifications were withdrawn and not published in the *Federal Register*. NHTSA officials told us that, since that time, the agency has sought to conduct additional review before final decisions could be made.

Although the policy decision as to whether to include pedestrian safety tests in NCAP ultimately resides within NHTSA's discretion, NHTSA's lack of a decision and its related rationale limits NHTSA's ability to address emerging safety risks and to meet its strategic objectives. Specifically, in the Department of Transportation's Enterprise Risk Profile for 2019, NHTSA recognized that increases in roadway fatalities in general—and pedestrian fatalities in particular—represent one of the top strategic risk areas for the Department.[66] The document states that to meet its objectives, NHTSA must focus on areas where there have been increases in road deaths, including pedestrian fatalities, and advance crash avoidance and mitigation technology to prevent crashes from occurring. NHTSA also recognized the importance of using a data-driven and systematic approach that is timely and complete when making decisions. In the absence of a decision on whether to include pedestrian safety testing in NCAP, and the rationale for that decision, stakeholders lack clarity on whether NHTSA is using all of the policy tools at its disposal to address emerging safety risks and to achieve its strategic objectives.

[65]49 U.S.C. § 32302(b).

[66]Department of Transportation, National Highway Traffic Safety Administration, *Enterprise Risk Management Risk Profile* (2019). This Risk Profile identifies potential risks to achieving an agency's goals and objectives and identifies strategies to mitigate these risks.

Conclusions

The design of vehicles and the safety features they offer can play an important role in reducing the frequency and severity of pedestrian crashes. NHTSA's pedestrian pilot program is an important step toward addressing data gaps on the relationship between vehicle characteristics and pedestrian injuries. Without an evaluation plan that includes criteria for assessing the scalability of the pilot program, however, NHTSA lacks the tools necessary to assess whether and how the pilot should be expanded into a more robust effort to inform NHTSA's understanding of pedestrian injury mitigation efforts.

Although NHTSA has recognized that the increase in pedestrian fatalities presents a risk to the safety of the nation's roadways, it is not well positioned to address this risk through NCAP because NHTSA does not have a clear process for making changes to the program. Documenting and communicating the process for updating NCAP, with clear criteria and decision points, would enhance NHTSA's accountability to key stakeholders—including Congress, automakers, and consumers—and help NHTSA communicate the important policy decision as to whether to include pedestrian safety tests in NCAP. Making and communicating a decision regarding pedestrian safety testing would give automakers clarity on whether NHTSA intends to establish performance standards and tests to evaluate the pedestrian safety features that are commonly available on new vehicle models. Communicating a decision and the rationale for that decision would provide transparency and accountability to the public.

Recommendations

We are making the following three recommendations to NHTSA.

The Administrator of NHTSA should document an evaluation plan for the Crash Injury Research and Engineering Network pedestrian pilot program that includes criteria for determining whether and how to scale the pilot program to ensure that the piloted data-collection and analysis procedures will address NHTSA's data needs related to pedestrian injuries and vehicle characteristics. (Recommendation 1)

The Administrator of NHTSA should document the overall process for making changes to NCAP, including established criteria and milestones

for decisions, and share this process with external stakeholders. (Recommendation 2)

The Administrator of NHTSA should decide whether to include pedestrian safety tests in NCAP and NHTSA should communicate this decision and rationale to relevant stakeholders and the public. (Recommendation 3)

Agency Comments and Our Evaluation

We provided a draft of this report to the Department of Transportation for review and comment. The department provided a written response, which is reprinted in appendix IV, and technical comments that we incorporated as appropriate in the report. The department concurred with all three of our recommendations. It described various activities NHTSA has underway related to pedestrian safety, including the CIREN study, a special study initiated this year to gather detailed data on a selection of fatal pedestrian crashes, and continuing research on pedestrian crash test procedures.

Regarding Recommendation 2, the department stated that it has made its procedures to change NCAP transparent and inclusive of the public. Specifically, the department stated it has published and requested comment on its proposals in the *Federal Register*, as we described in this report. However, the department agreed that documenting the overall process on its website would generate increased public awareness of NCAP as a consumer safety tool. While such a step could increase public awareness of NCAP, we continue to believe that any steps taken to document the overall process for making changes to NCAP should also include established criteria and milestones for decisions to enhance NHTSA's accountability to Congress, automakers, and consumers.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Transportation, and the Administrator of the National Highway Traffic Safety Administration. In addition, we will make copies available to others upon request, and the report will be available at no charge on the GAO website at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-2834, or vonaha@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix V.

Sincerely yours,

Andrew Von Ah
Director, Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

This report: (1) examines what is known about the relationship between motor vehicle characteristics and pedestrian injuries and fatalities, (2) describes approaches automakers have taken to address pedestrians' safety and discusses stakeholders' perspectives on these approaches, and (3) evaluates actions the National Highway Traffic Safety Administration (NHTSA) has taken to assess whether pedestrian safety testing should be included in its New Car Assessment Program (NCAP).

For all of our objectives we reviewed pertinent federal statutes and regulations and applicable program documents. Our work covered the 2008 through 2018 timeframe, with 2018 being the most recent data available at the time of our analysis. We focused on motor vehicles as opposed to infrastructure (e.g., roadway design, highway lighting) or driver/pedestrian behavior. Although infrastructure and behavior may also contribute to pedestrian fatalities and injuries, the scope of this report was to assess motor vehicles and their role in pedestrian safety. We defined motor vehicles as passenger cars, sport utility vehicles, and light trucks and vans that were offered for sale in the United States. We excluded commercial vehicles, motorcycles, and buses. The intent was to include those vehicles that a typical consumer would purchase and the pedestrian safety features that may or may not be offered on such vehicles.

Our scope also included gaining an understanding of pedestrian safety testing activities in Europe (European New Car Assessment Programme (Euro NCAP)) and Japan (Japan New Car Assessment Program (JNCAP)). We selected these programs since pedestrian safety testing is part of their NCAPs and some auto industry stakeholders identified them as being in the forefront of this type of testing. Both Europe and Japan began testing crash avoidance systems as part of their NCAPs in 2016. We interviewed officials with Euro NCAP, received a written response to questions from JNCAP, and obtained information on pedestrian safety testing from both organizations.

To examine what is known about the relationship between vehicle characteristics and pedestrian injuries and fatalities, we analyzed data

from three NHTSA databases for the period of 2008 through 2018: (1) Fatality Analysis Reporting System (FARS); (2) Crash Report Sampling Systems (CRSS); and (3) National Automotive Sampling System/General Estimates System (NASS/GES). To ensure the accuracy of our analysis we reviewed agency technical documentation related to these databases and ensured that our figures matched publicly available injury and fatality data contained in NHTSA publications such as its annual Traffic Safety Fact Sheets. FARS data are derived from a census of all fatal motor vehicle traffic crashes within the 50 states, Puerto Rico, and the District of Columbia and provide uniformly coded, national data on police reported fatalities. We analyzed FARS data to determine the total number of pedestrian fatalities each year as well as the number of pedestrian fatalities by vehicle age,[1] vehicle body type,[2] and vehicle travelling speed (speed just prior to the crash).[3] These variables were selected based on our interviews of NHTSA officials and a review of relevant research about the relationship between pedestrian fatalities and motor vehicle characteristics. We also analyzed FARS data on the number of pedestrian fatalities by environmental characteristics such as type of roadway, light condition, and relationship to intersection, selecting these characteristics based on our interviews and research.

CRSS is a sample of police reported motor vehicle crashes involving all types of motor vehicles, pedestrians, and cyclists that is used to develop national estimates of the number of injuries associated with motor vehicle crashes, among other things. The CRSS police crash report sample is selected in multiple stages to produce a nationally representative probability sample, and the target annual sample size is 50,000 police accident reports. We analyzed CRSS data from 2016 through 2018, the only years CRSS data were available, to better understand the estimated total number of pedestrian crashes as well as the estimated number of pedestrian crashes by vehicle age, vehicle body type, vehicle speed, and level of pedestrian injury severity. Similar to our analysis of FARS data, these variables were selected based on our interviews with NHTSA officials and a review of relevant research about the relationship between

[1]Vehicle age was calculated by subtracting the year of the crash from the model year of the vehicle. Vehicles with missing or not reported data were excluded from the calculation.

[2]For our data analysis, we used NHTSA's definitions of vehicle body type outlined in Appendix D of the Fatality Analysis Reporting System (FARS) Analytical User's Manual: 1975- 2017 (DOT HS 812 602).

[3]Traveling speed is a variable collected in the annual FARS vehicle data file. Although speed is also reflective of driver behavior (e.g., was the driver exceeding the posted speed limit), we considered speed as a physical property of the vehicle at the time of the crash.

motor vehicle characteristics and pedestrian crashes. NASS/GES preceded CRSS and obtained its data from a nationally representative probability sample of police accident reports. We analyzed NASS/GES data from 2008 through 2015, the most recent years available within the database, to better understand historical trend data on the variables we analyzed in CRSS. Although NHTSA collected similar variables in CRSS and NASS/GES, differences in the sampling methodologies of each may contribute to differences in the estimated number of pedestrian crashes between 2008 through 2015 and 2016 through 2018 timeframes.

We used agency technical documentation for CRSS and NASS/GES as well as guidance from NHTSA statisticians to estimate the sampling error associated with our estimates derived from CRSS and NASS/GES data. We express confidence levels of estimates derived from CRSS and NASS/GES data at the 95 percent confidence interval. This level means that we are 95 percent confident that the actual population values are within this interval. Additionally, for our analysis, we used CRSS and NASS/GES variables that included imputed values[4] for items missing data on the estimated number of pedestrian crashes by vehicle age, vehicle body type, and pedestrian injury severity. We reviewed and assessed NHTSA technical documentation for their statistical imputation methodology and determined it was sufficiently reliable for us to make use of the vehicle age, body type, and injury severity variables with imputed data.

In addition to analyzing NHTSA databases, we analyzed data from the Highway Loss Data Institute (HLDI), an organization affiliated with the Insurance Institute for Highway Safety (IIHS), to better understand how the U.S. vehicle fleet has changed, specifically between 2008 and 2018. HLDI collected and decoded vehicle identification numbers (VINs) for each model year between 1983 and 2018. For HLDI's analysis, it used VINs from its member companies, among other sources, and information encoded in the VIN to determine the body styles for these VINs. According to HLDI, passenger cars include regular two-door models, regular four-door models, station wagons, minivans, sports models and luxury models, while SUVs are vehicles with conventional front-end constructions and large passenger and cargo areas which can be built on

[4]In general, imputed values are estimated values for data elements that are missing or reported as unknown. According to NHTSA, it imputes a single value for selected missing data elements instead of estimating a set of plausible values. The imputation was done by NHTSA and the variables with imputed data are included in the standard data release for CRSS and GES.

either heavy-duty chassis capable of off-road use or passenger car platforms. HLDI definitions for vehicle body type classifications differ from those used by NHTSA. According to HLDI officials, however, the classifications are comparable. For our analysis, we used these data to calculate the proportion of vehicles that were passenger cars, light trucks, or SUVs from 2008 through 2018.

We also conducted interviews with federal government and non-governmental organizations about the relationship between vehicle related characteristics and pedestrian injuries and fatalities, as well as issues related to NHTSA's pedestrian safety data and potential data gaps and limitations. To discuss NHTSA's pedestrian safety data, we spoke with NHTSA officials from the Data Reporting and Information Division, Mathematical Analysis Division, and Vehicle Research and Test Center. We also spoke with officials from the National Transportation Safety Board, which conducts independent accident investigations and advocates for safety improvements, including those related to pedestrian safety and motor vehicles. Non-governmental organizations we spoke with included IIHS and major auto industry trade associations, such as the Alliance of Automobile Manufacturers, Association of Global Automakers, the Motor and Equipment Manufacturers Association, and the Automotive Safety Council. We also spoke with vehicle safety advocates, such as the Governors Highway Safety Association. These organizations were selected based on their relationship to the auto industry, referrals from other interviewees, and recent publications on pedestrian-motor vehicle safety issues. We also identified and reviewed studies either published or referenced by these organizations to better understand research related to pedestrian injuries and fatalities and motor vehicle characteristics. Where appropriate, we conducted a methodological review of these studies.

Further, we spoke with academic researchers from six research centers across four universities with expertise in human-vehicle interaction and pedestrian-motor vehicle safety, including injury biomechanics and auto industry data analysis. These researchers were selected based on referrals from other interviewees and reviews of their organization's websites to ensure that their research would be informative for our purposes. Although these organizations had, or have, relationships with NHTSA or the auto industry, we included them based on their expertise with issues related to our work. Based on these criteria we interviewed officials at the University of Virginia (Center for Applied Biomechanics); the Ohio State University (Center for Automotive Research; Injury Biomechanics Research Center); the University of North Carolina

(Highway Safety Research Center), and the University of Michigan (University of Michigan Transportation Research Institute; International Center for Automotive Medicine). We conducted interviews with these researchers to better understand general information on the relationship between vehicle-related characteristics and pedestrian injuries and fatalities, uses and limitations of NHTSA data, and potential areas for further research. Results of our interviews are not generalizable to the universe of non-governmental organizations or researchers studying pedestrian-motor vehicle safety. We also spoke with automakers and equipment suppliers about pedestrian safety and data needs. The automakers and equipment suppliers were the same as those contacted about how automakers are addressing pedestrian safety (discussed below).

Finally, we reviewed documents and interviewed NHTSA officials about the Crash Injury Research and Engineering Network (CIREN) and the associated CIREN pedestrian pilot program NHTSA recently initiated. This pilot will assess data collection approaches and methodologies for pedestrian injuries resulting from motor vehicle crashes. Specifically, we reviewed CIREN contract and methodology documents such as the 2016 CIREN Request for Proposal, 2018 CIREN Pedestrian Pilot Study Request for Proposal, Task Orders for CIREN centers participating in the pedestrian pilot study, CIREN Pedestrian Crash Process and Coding Manual, and the Pedestrian Crash Inclusion Criteria. We also interviewed NHTSA officials responsible for managing the CIREN program and the pedestrian pilot study. We assessed this program using criteria for designing successful pilot programs developed during prior GAO work.[5]

To describe the approaches automakers have taken to address pedestrian-motor vehicle safety and discuss stakeholder perspectives on these approaches, we contacted automakers that sell new vehicles in the United States. Specifically, NHTSA provided us with a list of 17 automakers that participated in the 2018 New Car Assessment Program. NHTSA officials told us they do not necessarily include automakers with low sales volumes in NCAP testing. As a result, to better ensure that we had a complete list of automakers that sell vehicles in the United States we compared the names on NHTSA's listing to the membership lists of the Alliance for Automobile Manufacturers and the Association of Global

[5]GAO, *Data Act: Section 5 Pilot Design Issues Need to Be Addressed to Meet Goal of Reducing Recipient Reporting Burden,* GAO-16-438 (Washington, D.C.: April 19, 2016)

Automakers—two major trade associations of the auto industry.[6] Officials told us that between the two organizations we would account for most, if not all, of the automakers that sell new vehicles in the United States. Finally, we compared our list with 2018 market share data from Ward's Automotive[7] to identify the automakers with the highest U.S. sales. Based on our analysis, we identified 17 automakers to include in our work. However, during our contacts with automakers, we determined that one of the 17 automakers—Porsche—was part of the Volkswagen Group. Thus, our final review resulted in a total of 16 automakers to contact as part of our study (see table 2). Thirteen of the 16 automakers responded to our request for information.

Table 2: List of Automakers Contacted by GAO Study

Name	Vehicle brands
American Honda Motor Company Incorporated	Honda, Acura
BMW Group	BMW, Mini Cooper, Rolls Royce
Fiat Chrysler Automobiles, US LLC	Fiat, Chrysler, Dodge, Alfa Romeo, Jeep, Ram
Ford Motor Company	Ford, Lincoln
General Motors Company	Buick, Cadillac, Chevrolet, GMC
Hyundai Motor Company; Kia Motors Corporation	Hyundai, Kia
Jaguar Land Rover North America, LLC	Jaguar, Land Rover
Mazda North America	Mazda
Mercedes Benz USA	Mercedes Benz
Mitsubishi Motors Corporation	Mitsubishi
Nissan Motor Corporation	Nissan, Infinity, Datsun
Subaru	Subaru
Tesla Inc.	Tesla
Toyota Motor Corporation	Toyota, Lexus
Volkswagen Group	Audi, Volkswagen, Porsche
Volvo Group	Volvo

Source: GAO | GAO-20-419

[6]In January 2020, the Alliance for Automobile Manufacturers and the Association of Global Automakers merged to form the Alliance for Automotive Innovation. According to the new organization, it represents automakers that sell about 99 percent of all light-duty vehicles in the United States.

[7]Ward's Automotive is a subsidiary of Informa PLC.

We developed a semi-structured interview instrument to collect information from the automakers. This instrument focused on the approaches that automakers took to address pedestrian-motor vehicle safety. The semi-structured interview instrument was peer reviewed by an independent survey specialist and pretested with two automakers before we began collecting data. Based upon on their responses, we revised and clarified the semi-structured interview instrument. In total, 13 of 16 automakers completed and submitted the semi-structured interview instrument. Those 13 automakers represented approximately 70 percent of new vehicle sales in the United States for 2018. The interview instrument asked automakers to identify pedestrian safety features on their 2019 model year vehicles, as these vehicles would have the most recent pedestrian safety features available at the time of our work. Although 12 of the 13 automakers did not respond in full to all the questions on the semi-structured interview instrument, we obtained additional information through telephone and in-person interviews conducted from May 2019 through October 2019. The results of these interviews are not generalizable to the universe of automakers that may sell vehicles in the United States. Upon completion of all the interviews, a GAO methodologist compiled the individual responses from each of the 13 automakers into a database. We used this database to perform a qualitative content analysis to identify common themes and the frequency with which the automakers identified certain issues related to pedestrian safety. A GAO analyst independently verified the themes and certain other information we received from the automakers to ensure accuracy and completeness.

We also used semi-structured interview instruments to obtain information on stakeholders' perspectives on the approaches automakers have taken to pedestrian safety. For purposes of this report, we define stakeholders as automakers, auto equipment suppliers, and auto industry trade associations. These organizations develop or deploy pedestrian safety technology in motor vehicles, or, in the case of the trade associations, are knowledgeable about the legal and regulatory issues related to pedestrian safety and the auto industry. In addition to interviewing 13 automakers, we interviewed officials from five auto equipment suppliers and four auto industry trade associations (see table 3). The five auto equipment suppliers included in our work were identified with the assistance of the Motor and Equipment Manufacturers Association, a trade association for auto industry suppliers. The organization provided us the names of seven equipment suppliers, five of which agreed to participate in our semi-structured interviews. In general, these equipment suppliers develop or produce equipment used in motor vehicle crash avoidance or crash

mitigation systems. The semi-structured interview instrument asked questions about such things as crash avoidance and crash mitigation technology and the benefits and challenges of this technology. We did not assess the effectiveness of these features. Additionally, we interviewed officials from four auto industry trade associations. We conducted telephone and in-person interviews with these stakeholders from March 2019 through September 2019.

Table 3: List of Auto Equipment Suppliers and Trade Associations Participating in GAO Study

Name
Auto equipment suppliers: Aptiv, PLC
Auto equipment suppliers: Autoliv, Inc.
Auto equipment suppliers: Robert Bosch, LLC
Auto equipment suppliers: Denso International
Auto equipment suppliers: Saudi Arabia Basic Industrial Corporation (SABIC)
Trade Associations: Alliance of Automobile Manufacturers Inc.
Trade Associations: Association of Global Automakers
Trade Associations: Automotive Safety Council
Trade Associations: Motor and Equipment Suppliers Association

Source: GAO | GAO-20-419

In addition to automakers, equipment suppliers, and auto industry trade associations, we also interviewed NHTSA and IIHS about crash avoidance and crash mitigation technology and reviewed applicable federal regulations related to pedestrian safety. These include federal headlight and bumper standards.[8] We also reviewed an October 2018 Notice of Proposed Rulemaking in which NHTSA agreed to evaluate proposed amendments to current federal motor vehicle headlight requirements.[9] We discussed with NHTSA the federal headlight and bumper standards and how these relate to pedestrian safety, as well as any potential changes to these standards to better accommodate pedestrian safety. Lastly, we reviewed an October 2019 IIHS press release and an October 2019 American Automobile Association study

[8]49 C.F.R. § 571.108, *Standard No. 108; Lamps, reflective devices, and associated equipment*, and 49 C.F.R. Part 581, *Bumper Standard*.

[9]Department of Transportation, National Highway Traffic Safety Administration, Notice of Proposed Rulemaking, *Federal Motor Vehicle Safety Standards; Lamps, Reflective Devices, and Associated Equipment,* 83 Fed. Reg. 51766 (Oct. 12, 2018).

discussing the results of pedestrian crash avoidance tests each organization performed.

To assess NHTSA's actions related to pedestrian safety and NCAP, we reviewed applicable federal laws and regulations related to vehicle safety as well as documents published in the *Federal Register*, such as Requests for Comments, soliciting comments on proposed NCAP changes related to pedestrian safety. NHTSA provided a high-level summary of comments received from Requests for Comments issued in 2015 and 2018 that we reviewed. We reviewed selected comments and supporting documents submitted to NHTSA as part of the docket in support of the Requests for Comment, such as those provided by auto industry trade associations, automakers, and auto equipment suppliers. We also reviewed program documents discussing how NHTSA assesses new car safety, performs NCAP safety tests, and reports the results to the public. Further, we reviewed over 55 studies and presentations on the agency's work related to pedestrian safety. NHTSA highlighted 22 of these reports and presentations as being representative of the body of research that supported and facilitated agency decisions and policies with respect to pedestrian safety, including the 2015 and 2018 Requests for Comments. We reviewed the 22 reports and presentations and determined that 14 met our inclusion criteria, in that the reports and presentations were focused on potential pedestrian safety tests and their applicability to the U.S. vehicle fleet, the use of various test instruments, and the potential safety effects associated with technologies intended to avoid and mitigate crashes. Where appropriate, we conducted a methodological review of these studies. In addition, NHTSA officials provided additional studies after our interviews, which we also reviewed.

To better understand pedestrian safety testing and issues related to incorporating such testing into NCAP, we visited NHTSA's Vehicle Research and Test Center in East Liberty, Ohio. We interviewed officials there about NHTSA pedestrian safety research and how it supported NHTSA's proposed pedestrian safety tests for NCAP. We also discussed the applicability of pedestrian safety tests to the U.S. vehicle fleet, including tests used by Euro NCAP. During our visit, we observed examples of a pedestrian crash mitigation test for lower leg injury and a rear-facing pedestrian crash avoidance test. We reviewed NHTSA's budget documentation on pedestrian safety research from fiscal year 2008 to 2019, the most recent year for which data were available. We also visited and discussed pedestrian safety issues with officials of IIHS' Vehicle Research Center in Ruckersville, Virginia. We observed a forward-facing pedestrian crash avoidance test. Further, we interviewed

NHTSA officials about such things as the process for making changes to NCAP and activities associated with this process, documentation of this process, how NCAP changes are communicated to stakeholders, and NHTSA plans for determining whether to incorporate pedestrian safety tests in NCAP. Finally, we interviewed automakers, auto industry equipment suppliers, and IIHS about incorporating pedestrian safety tests into NCAP.

To understand how other NCAPs address pedestrian safety, we interviewed officials from Euro NCAP and received written responses from JNCAP to a set of questions we sent them. We also reviewed supporting documents from both Euro NCAP and JNCAP on pedestrian crash avoidance and mitigation tests they perform and how such tests are scored when determining star ratings. Further, we discussed with Euro NCAP how it works with the auto industry to test vehicles and to develop future changes to Euro NCAP, including the Euro NCAP roadmap. We also reviewed selected international studies related to the real-world benefits of pedestrian safety testing performed by Euro NCAP. We determined those studies to be sufficiently reliable for our purposes.

To assess how NHTSA's process for making changes to NCAP compares to leading practices, we reviewed the Project Management Institute, Inc., *The Standard for Program Management*, and GAO's *Standards for Internal Control in the Federal Government*.[10] The Project Management Institute's standards are utilized worldwide and provide guidance on how to manage various aspects of projects, programs, and portfolios. In particular, according to *The Standard for Program Management*, this standard provides guidance that is generally recognized to support good program-management practices for most programs, most of the time.

We conducted our work from February 2019 to April 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[10]Project Management Institute, Inc., *The Standard for Program Management*, Fourth Edition (2017) and GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 2014).

Appendix II: Additional Data on Pedestrian Crashes in the United States, 2008 through 2018

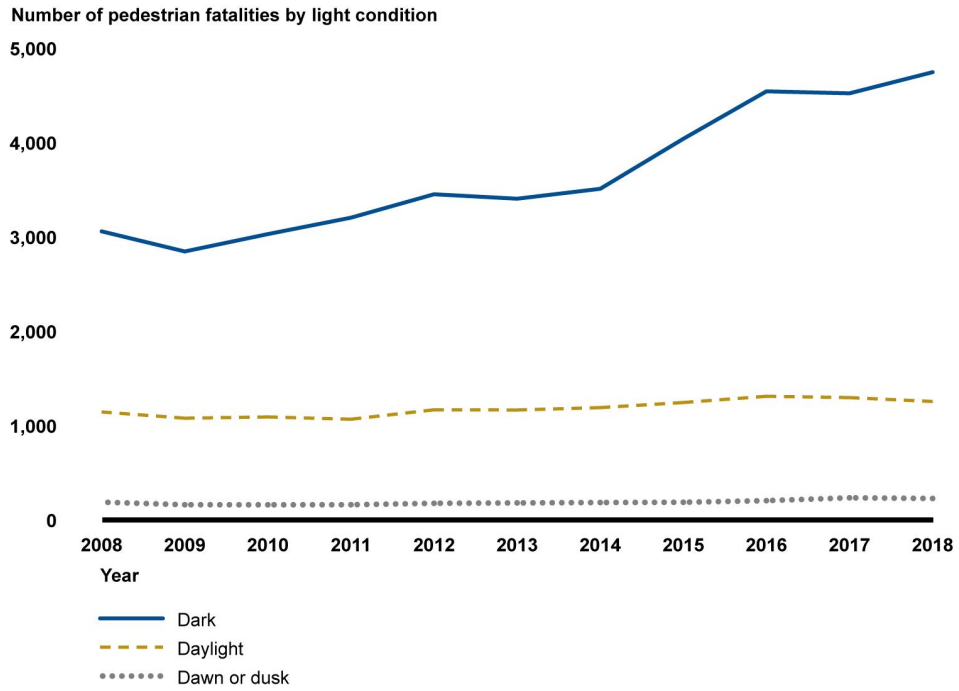
This appendix contains additional information on pedestrian fatalities and the estimated number of pedestrians injured[1] from 2008 through 2018.

Pedestrian Fatalities

Although we included much of our pedestrian fatality analysis in the report, this appendix includes data on the number of pedestrian fatalities involving particular light conditions and relationships to intersections—environmental factors relevant to pedestrian crashes—as well as data on vehicle body types (see fig. 11, 12, and 13). We used data from the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS) to compile information on pedestrian fatalities.

[1]Our analysis of pedestrian injuries includes the number of pedestrians with possible, suspected minor, suspected serious, fatal, and unknown severity injuries. It does not include pedestrians where "no apparent injury" was reported.

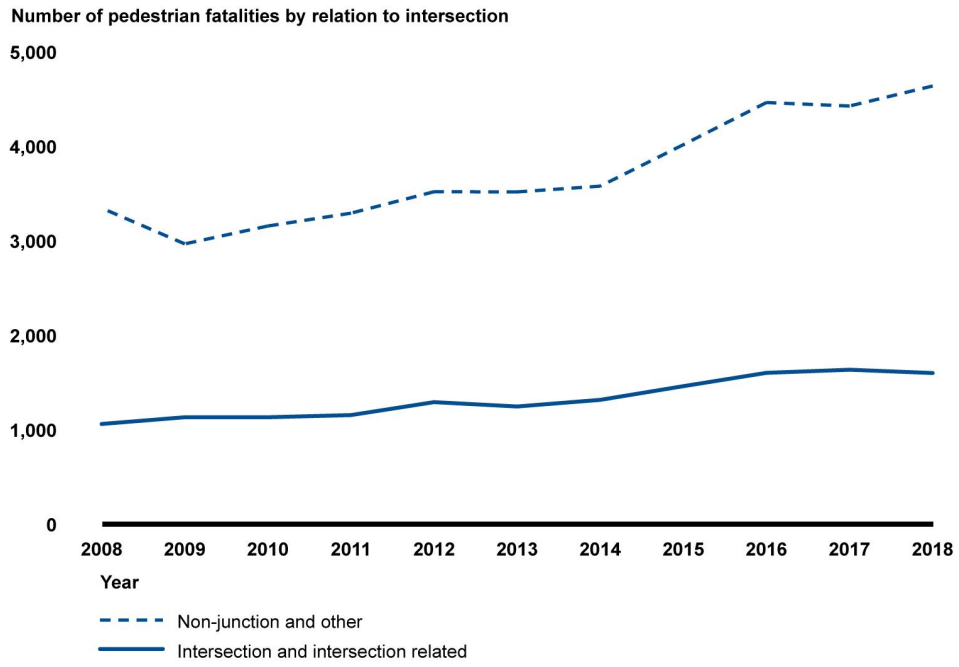
Figure 11: Number of Pedestrian Fatalities by Light Condition, 2008 though 2018



Source: GAO analysis of National Highway Traffic Safety Administration Fatality Analysis Reporting System data. | GAO-20-419

Note: Pedestrian fatalities where the light condition was unknown, not reported or other are not shown.

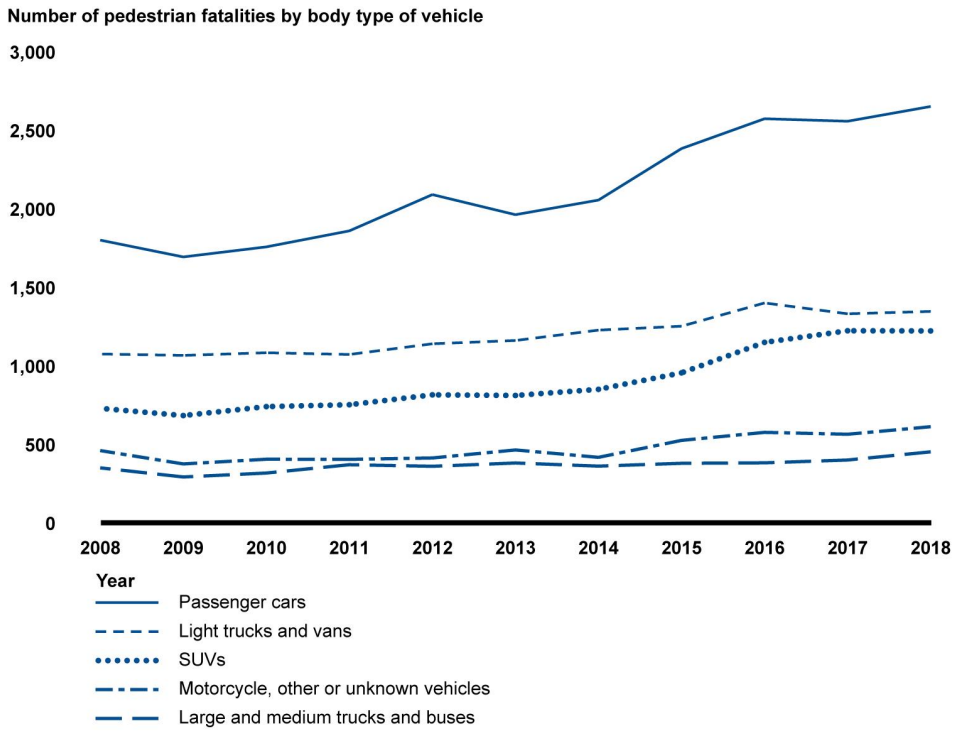
Figure 12: Number of Pedestrian Fatalities by Relation to Intersection, 2008 through 2018



Source: GAO analysis of National Highway Traffic Safety Administration Fatality Analysis Reporting System data. | GAO-20-419

Note: Pedestrian fatalities where the relation to intersection was unknown or not reported are not shown.

Figure 13: Number of Pedestrian Fatalities by Body Type of Vehicle That Struck the Pedestrian, 2008 through 2018



Source: GAO analysis of National Highway Traffic Safety Administration Fatality Analysis Reporting System data. | GAO-20-419

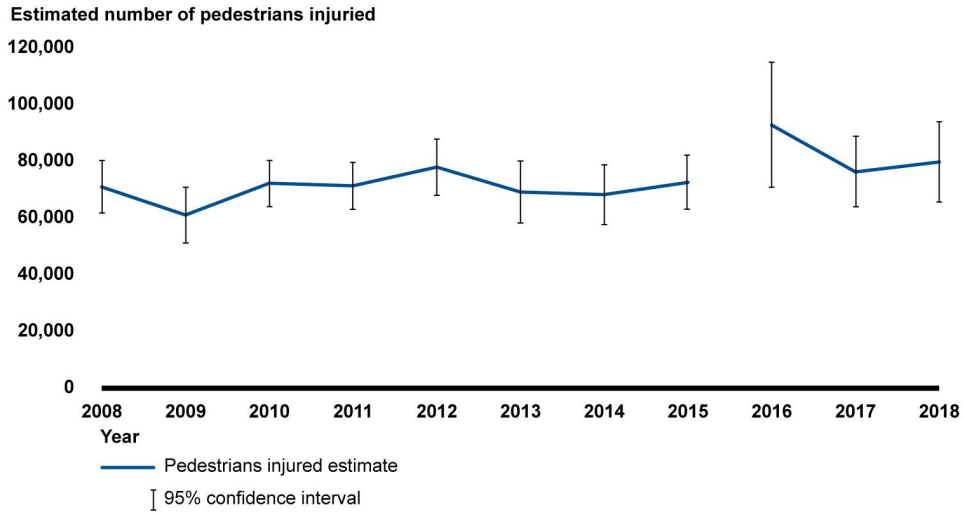
Note: Pedestrian fatalities where the body type of the vehicle that stuck the pedestrian was unknown or other are not shown. For our analysis, we used NHTSA's classifications for vehicle body types, but we combined body type classifications to create our "Motorcycles and Other/Unknown Vehicles" and "Large/Medium Trucks/ Buses" categories. NHTSA defines passenger cars as light vehicles such as sedans, hatchbacks, coupes, and convertibles that are designed primarily to transport eight or fewer persons. NHTSA's light trucks and vans definition includes light conventional trucks, van-based light trucks, and other light trucks. Light conventional trucks include pickup trucks and other vehicles designed with small passenger cabs, large hoods, and an open cargo area. Van-based light trucks include minivans and other vehicles designed to maximize enclosed cargo and passenger areas, and other light trucks, are vehicles based upon a conventional light pickup frames, but may include commercial or recreational vehicle body features. NHTSA defines SUVs or utility vehicles as multipurpose vehicles with increased ground clearance and strong frames, which are generally designed for carrying persons and off-road capabilities. NHTSA's definition of motorcycle includes vehicles such as two and three wheel motorcycles, mopeds, motor scooters, and all-terrain vehicles, and its other vehicles classification includes other motored vehicles designed primarily for off-road use such as snowmobiles, golf carts, and construction equipment. Large/medium trucks are defined as single unit trucks designed for carrying cargo on the same frame as the passenger cab. Lastly, NHTSA defines buses as motor vehicles designed to transport large groups of passengers.

Pedestrian Injuries

The following figures show information about the estimated number of pedestrians injured from 2008 through 2018 (see figs. 14, 15, 16, 17, and

18). These figures show pedestrians injured by age of the striking vehicle, body type of vehicle, reported speed of the vehicles, and estimated number of pedestrians with serious or fatal injuries. We used data from NHTSA's Crash Report Sampling System (CRSS) for years 2016 through 2018, and National Automotive Sampling System/General Estimates Survey (NASS/GES) for years 2008 through 2015 to compile information on pedestrians injured.[2] Within CRSS and NASS/GES databases, we specifically analyzed data on pedestrians injured by vehicle related characteristics such as the age, body type, and speed of vehicles that struck and injured pedestrians, as well as the estimated number of severe and fatal pedestrians injured.[3]

Figure 14: Estimated Number of Pedestrians Injured in the United States, 2008 through 2018



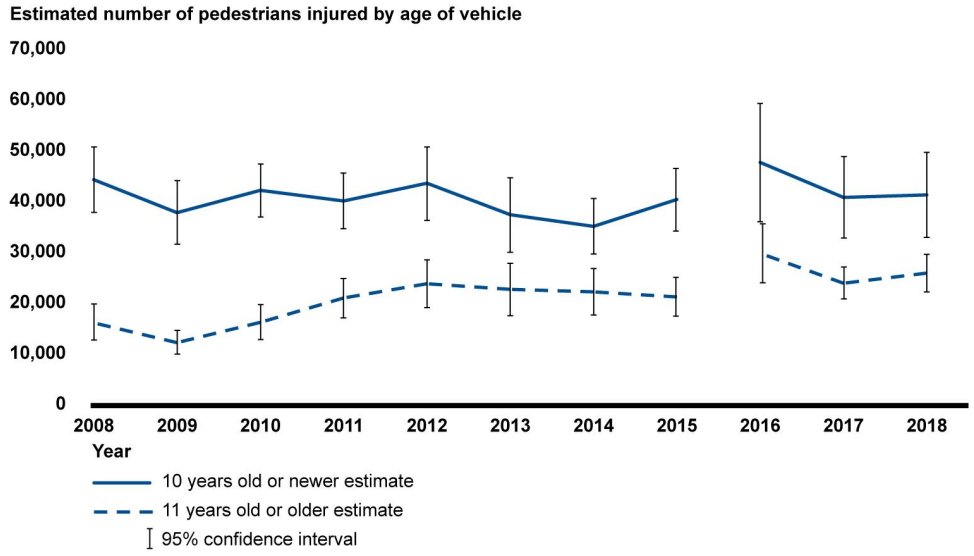
Source: GAO analysis of the National Highway Traffic Safety Administration's (NHTSA) Crash Report Sampling System (CRSS) data from 2016 to 2018 and General Estimates System (GES) data from 2008 to 2015. | GAO-20-419

Note: Differences in the methodologies of each dataset may account for differences in the estimated number of pedestrian crashes. Error bars represent the 95 percent confidence interval for each yearly estimate.

[2]NHTSA replaced GES with CRSS after 2015, and although NHTSA collected similar variables in each dataset, differences in the data collection methodologies of each may account for differences in the estimated number of pedestrian crashes. Data from 2018 were the most recently available from CRSS, and data from 2015 were the most recently available from GES.

[3]We selected these variables to match our earlier analysis of NHTSA's Fatality Analysis Reporting System (FARS). As with FARS, these factors cannot be used to solely determine the cause of a particular crash or fully explain the trends in the estimated numbers of pedestrian crashes since 2008.

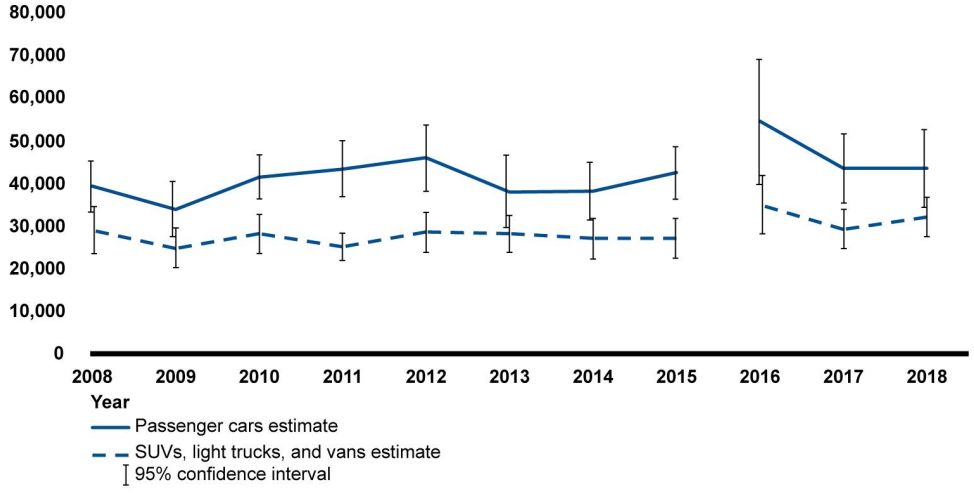
Figure 15: Estimated Number of Pedestrians Injured by Age of Vehicle That Struck the Pedestrian, 2008 through 2018



Source: GAO analysis of the National Highway Traffic Safety Administration's (NHTSA) Crash Report Sampling System (CRSS) data from 2016 to 2018 and General Estimates System (GES) data from 2008 to 2015. | GAO-20-419

Note: Differences in the methodologies of each dataset may account for differences in the estimated number of pedestrian crashes. Error bars represent the 95 percent confidence interval for each yearly estimate. Crashes where the age of the vehicle that struck the pedestrian was unknown or not reported are not shown in this figure.

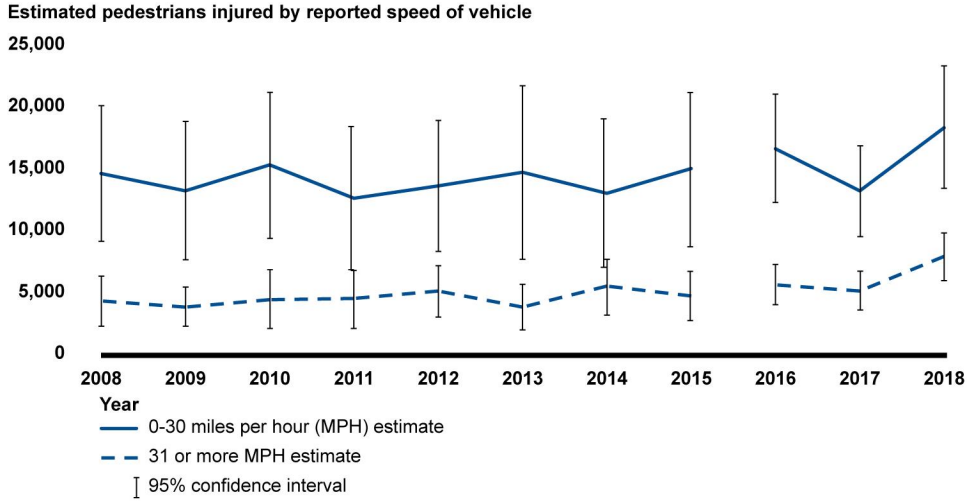
Figure 16: Estimated Number of Pedestrians Injured by Body Type of Vehicle That Struck the Pedestrian, 2008 through 2018



Source: GAO analysis of the National Highway Traffic Safety Administration's (NHTSA) Crash Report Sampling System (CRSS) data from 2016 to 2018 and General Estimates System (GES) data from 2008 to 2015. | GAO-20-419

Note: Differences in the methodologies of each dataset may account for differences in the estimated number of pedestrian crashes. Error bars represent the 95 percent confidence interval for each yearly estimate. This figure includes imputed values, which are estimated values for data elements that are missing or reported as unknown. According to NHTSA, it imputes a single value for selected missing data elements instead of estimating a set of plausible values. Crashes where the body type of the vehicle that struck the pedestrian was a large/medium truck, bus, motorcycle, other vehicle type or unknown are not shown in this figure. For our analysis, we used NHTSA's classifications for vehicle body types, but we combined body type classifications to create our "SUVs, Light Trucks, and Vans" category. NHTSA defines passenger cars as light vehicles such as sedans, hatchbacks, coupes, and convertibles that are designed primarily to transport eight or fewer persons. NHTSA defines SUVs or utility vehicles as multipurpose vehicles with increased ground clearance and strong frames, which are generally designed for carrying persons and off-road capabilities. NHTSA's light trucks definition includes light conventional trucks, such as pickup trucks and other vehicles designed with small passenger cabs, large hoods, and an open cargo area. Other light trucks are used to describe vehicles based upon a conventional light pickup frame, but may include commercial or recreational vehicle body features. Van-based light trucks includes minivans and other vehicles designed to maximize enclosed cargo and passenger areas.

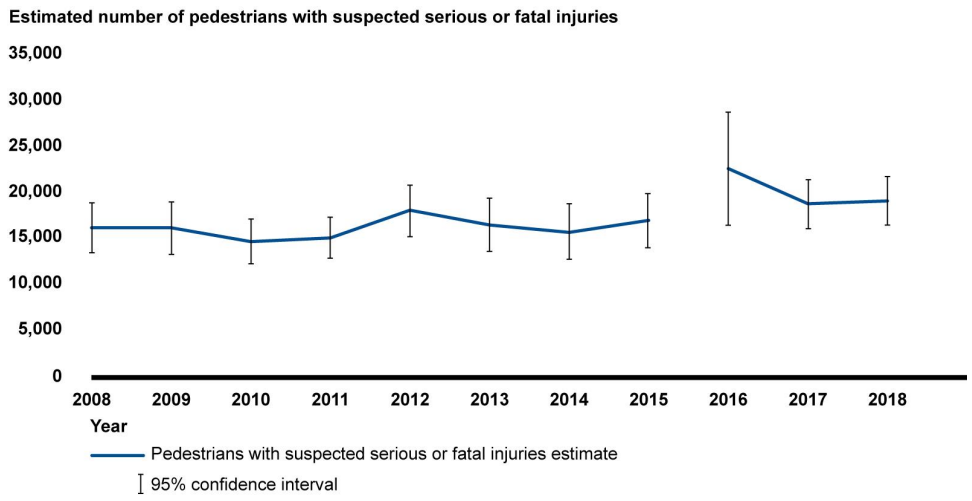
Figure 17: Estimated Number of Pedestrians Injured by Reported Speed of the Vehicle That Struck the Pedestrian, 2008 through 2018



Source: GAO analysis of the National Highway Traffic Safety Administration's (NHTSA) Crash Report Sampling System (CRSS) data from 2016 to 2018 and General Estimates System (GES) data from 2008 to 2015. | GAO-20-419

Note: Differences in the methodologies of each dataset may account for differences in the estimated number of pedestrian crashes. Error bars represent the 95 percent confidence interval for each yearly estimate. Crashes where the speed of the vehicle that struck the pedestrian was missing or not reported are not shown in this figure.

Figure 18: Estimated Number of Pedestrians with Suspected Serious or Fatal Injuries, 2008 through 2018



Source: GAO analysis of the National Highway Traffic Safety Administration's (NHTSA) Crash Report Sampling System (CRSS) data from 2016 to 2018 and General Estimates System (GES) data from 2008 to 2015. | GAO-20-419

Note: Differences in the methodologies of each dataset may account for differences in the estimated number of pedestrian crashes. Error bars represent the 95 percent confidence interval for each yearly estimate. This figure includes imputed values, which are estimated values for data elements that are missing or reported as unknown. According to NHTSA, it imputes a single value for selected missing data elements instead of estimating a set of plausible values. Crashes involving pedestrians with no apparent injury, possible injuries, suspected minor injuries, or where the injury severity was unknown or not reported are not shown in this figure.

Appendix III: Benefits and Challenges of Pedestrian-Motor-Vehicle Safety Features

As part of our analysis on how automakers are addressing pedestrian safety through crash avoidance and crash mitigation technologies, we obtained the views of 13 automakers and five auto equipment suppliers. As discussed below, auto industry officials provided their views on the benefits and challenges of commonly available crash avoidance and crash mitigation technologies.

Crash Avoidance Benefits and Challenges

Automaker and auto equipment supplier officials identified various benefits and challenges with pedestrian crash avoidance features. For example, 12 of 13 automakers reported and two of five auto equipment suppliers said that crash avoidance features have the overall potential benefit of eliminating or reducing car-to-pedestrian accidents. The Highway Loss Data Institute reported in 2017 that one automaker's pedestrian automatic emergency braking system reduced pedestrian-related bodily injury liability claims by 35 percent compared to other vehicles manufactured by that automaker.[1] In addition, the automaker itself found that, in Japan, its vehicles equipped with the system experienced 60 percent fewer accidents with injury compared to its vehicles without the system.

Officials from automakers and auto equipment suppliers we interviewed also identified challenges with pedestrian crash avoidance technologies. Specifically, stakeholders cited some distinctions between the performance of camera-based and radar-based pedestrian automatic emergency breaking systems. Almost half of the automakers we interviewed (six of 13) reported that a primary challenge with a camera-based pedestrian automatic emergency braking system was the camera's

[1]Highway Loss Data Institute, Bulletin, Vol. 34, No. 39 (Arlington, VA: Dec. 2017).

ability to work in low lighting and poor weather. As previously noted in this report, about 75 percent of all reported pedestrian fatalities occurred in 2018 after dark.

In contrast, several automakers stated that radar based pedestrian detection systems are not dependent on light to function, but that they are less effective at identifying pedestrians than camera-based systems. Officials from another automaker said manufacturers have attempted to offset the challenges of cameras and radar by developing "fusion" systems (combination of camera and radar). These officials said, however, these systems add complexity and processing time to the technology because the system must manage two separate functions that must be processed together to identify a pedestrian. Officials from automakers said that a challenge affecting both camera- and radar-based systems was limiting the occurrence of false positives, or the activation of these systems when they are not required.

Recently issued research has raised questions about the overall effectiveness of crash avoidance systems. In October 2019, the American Automobile Association (AAA) reported that, based on its own assessment, some vehicles' pedestrian safety systems were inconsistent at either slowing down or stopping a vehicle to avoid hitting a pedestrian.[2] For example, AAA reported that dark conditions could affect the effectiveness of available pedestrian detection systems and that none of the crash avoidance systems on the four vehicles they tested worked in dark conditions.

Automaker officials told us that the performance of crash avoidance systems could be improved through updates to current vehicle headlight standards.[3] Specifically, officials from four automakers indicated that the National Highway Traffic Safety Administration (NHTSA) should update federal standards for headlights to permit the use of adaptive driving

[2]American Automobile Association, Inc. *Automatic Emergency Braking with Pedestrian Detection* (October 2019).

[3]According to IIHS, it has conducted tests of vehicle headlight effectiveness. In 2016, the IIHS stated it released its first headlight ratings and reported that only one system out of 31 model year 2016 midsize cars received a good rating. As of March 2019, 14 percent of headlight systems tested on model year 2019 vehicles received a good rating. IIHS rated more than half of vehicles headlights as marginal or poor because of inadequate visibility, excessive glare from low beams for oncoming drivers, or both.

beam headlights on new vehicles.[4] Adaptive driving beam headlights are currently in use in European and other countries, and are different from the combination high- and low-beam systems used in the United States. In general, adaptive driving beam headlights use advanced sensors and computing technology to shape the headlamp beams to provide enhanced illumination of unoccupied portions of the road and avoid glaring other vehicles.

In October 2018, NHTSA published a Notice of Proposed Rulemaking in which it tentatively concluded that federal standards for headlights do not permit adaptive driving beam systems because those systems would not comply with some of the standards.[5] NHTSA, however, has said adaptive driving beam headlights have the potential to create significant safety benefits in avoiding collisions with pedestrians, cyclists, animals, and roadside objects by providing additional front-end illumination. Five automakers we interviewed said that they offer adaptive driving beam headlamps as a crash avoidance technology on their vehicles sold in other countries. In its October 2018 Notice of Proposed Rulemaking, NHTSA sought public comment on amending federal standards to allow the use of adaptive driving beam systems in response to a petition from an automaker. NHTSA officials said that it is in the process of developing a final rule but did not have a period for when it would be issued.

Another challenge for crash avoidance systems is the federal standard for bumpers.[6] As previously discussed in this report, this standard requires that vehicles, including their bumpers, meet specified damage criteria when bumpers are hit at 2.5 miles-per-hour (mph).[7] Officials from five automakers said that this standard presented challenges with the placement of crash avoidance sensors. On some vehicles, crash avoidance sensors are placed in the same area where the vehicles are tested for compliance with the bumper standard. As a result, the test could damage or destroy the crash avoidance sensor. Two automaker

[4]49 C.F.R. § 571.108. Federal Motor Vehicle Safety Standard (FMVSS) Number 108, *Lamps, reflective devices, and associated equipment* specifies requirements for original and replacement lamps, reflective devices, and associated equipment.

[5]Department of Transportation, National Highway Traffic Safety Administration, Notice of Proposed Rulemaking*, Federal Motor Vehicle Safety Standards; Lamps, Reflective Devices, and Associated Equipment,* 83 Fed. Reg. 51766 (Oct. 12, 2018).

[6]49 C.F.R. Part 581, Bumper Standard.

[7]The FMVSS related to bumpers only applies to passenger vehicles and not trucks or SUVs.

officials told us that they have addressed this challenge by relocating the sensors to another part of the vehicle to avoid conflicts with the bumper standard. NHTSA officials told us they are in the process of reevaluating the bumper damageability standard, including the placement of sensors, as part of a Notice of Proposed Rulemaking, which they expect to publish in early 2020.

Crash Mitigation Benefits and Challenges

Officials from automakers and auto equipment suppliers we interviewed identified benefits and challenges for pedestrian crash mitigation features. For example, 12 of 13 automakers reported and one of five auto equipment suppliers said that pedestrian crash mitigation features have the overall benefit of reducing the risk or severity of pedestrian injuries. Officials from four automakers, however, said that crash mitigation features do not protect pedestrians from the secondary impact of an accident, such as the residual injuries from hitting the pavement. Additionally, officials from six automakers said that crash avoidance features were more effective than crash mitigation features because the purpose of crash avoidance features is to prevent the collision from occurring in the first place.

Similar to crash avoidance, the federal bumper standard may also affect crash mitigation systems. Officials from eight automakers said that the bumper standard created challenges to offering additional crash mitigation features in the United States, such as softer, more pedestrian friendly bumpers.[8] Officials from the eight automakers said they offered softer bumpers in Europe or elsewhere—where there is no similar bumper standard—but do not offer softer bumpers in the United States. Some stakeholders told us the current bumper standard runs counter to pedestrian safety, and softer bumpers would help mitigate the severity of pedestrian injuries. Similarly, NHTSA officials told us the current bumper standard is primarily a cost savings standard in that it is intended to reduce repair costs and not necessarily to offer safety protection for vehicle occupants. NHTSA officials told us that establishing a bumper standard that addresses pedestrian safety, yet minimizes bumper damage and repair costs requires tradeoffs. The officials told us as part of

[8]As previously discussed in this report, NHTSA officials said that the bumper standard is intended to prevent damage to the car body and safety related equipment at speeds equivalent to a 5 mph crash into a parked vehicle of the same weight.

the Notice of Proposed Rulemaking it is reviewing the broader damageability requirement.

Appendix IV: Comments from the U.S. Department of Transportation

U.S. Department of Transportation
Office of the Secretary of Transportation

Assistant Secretary
for Administration

1200 New Jersey Avenue, SE
Washington, DC 20590

April 6, 2020

Andrew Von Ah
Director, Physical Infrastructure Issues
U.S. Government Accountability Office (GAO)
441 G Street NW
Washington, DC 20548

Dear Mr. Von Ah:

The National Highway Traffic Safety Administration (NHTSA) leverages its available tools to improve the safety of vulnerable road users, including pedestrians. This year, in addition to the Crash Injury Research (CIREN) pedestrian study, NHTSA initiated a special study to gather detailed data on a selection of fatal pedestrian crashes. NHTSA is continuing its research on pedestrian crash test procedures by conducting tests with advanced legforms equipped with an upper body mass component, as well as evaluating test protocols that build on the global technical regulation tests that are in use or under development internationally. NHTSA is also evaluating nighttime performance of Pedestrian Automatic Emergency Braking systems and the feasibility and benefits of integrated passive and active pedestrian safety countermeasures. In addition, on October 16, 2019, NHTSA announced its plan to propose major updates to the New Car Assessment Program (NCAP) that are anticipated to include, for example, considerations for technologies to increase the safety of pedestrians.

NHTSA has the following actions underway to further improve NCAP:

- Exploring the readiness and development of advanced driver assistance technologies, including those for pedestrians, for consideration in NCAP.
- Developing a detailed proposal on next steps for NCAP that is anticipated to include pedestrian safety. NHTSA plans to publish the proposal in the Federal Register and seek public comment later this year.

Upon review of the GAO's draft report, NHTSA concurs with Recommendations 1, 2 and 3. Regarding Recommendation 2 to "document the overall process for making changes to NCAP, including established criteria and milestones for decisions, and share this process with external stakeholders," NHTSA notes that it has made the procedures used to change NCAP transparent and inclusive of the public. The agency has published its proposals for upgrading NCAP in the Federal Register, requested public comment on the proposals, and carefully considered all comments.[1] To further engage external stakeholders, NHTSA has held public meetings on some

[1] NHTSA, Request for Comment, NCAP, 80 FR 4630 (Jan. 28, 2015) (proposing to add automatic emergency braking (AEB) to NCAP); and NHTSA, Final Decision, NCAP, 80 FR 69604 (Nov. 5, 2015) (announcing the agency's final decision to add AEB to NCAP).

proposals. As an added measure, NHTSA agrees that documenting the overall process on the agency's website will generate more public awareness of this important consumer safety tool. We will provide a detailed response to each recommendation within 180 days of the final report's issuance.

Please contact Madeline M. Chulumovich, Director, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if you would like to obtain additional details.

Sincerely,

Keith Washington
Deputy Assistant Secretary for Administration

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

Andrew Von Ah, Director, (202) 512- 2834 or vonaha@gao.gov

Staff Acknowledgements

In addition to the contact named above, Matt Barranca (Assistant Director), Richard Jorgenson (Analyst-in-Charge), Carl Barden, Namita Bhatia-Sabharwal, Melissa Bodeau, Breanne Cave, Michelle Everett, Susan Fleming, Geoff Hamilton, Hannah Laufe, Regina Morrison, Joshua Ormond, Terry Richardson, and Michael Steinberg made significant contributions to this report.

Appendix VI: Accessible Data

Data Tables

Accessible Data for Figure 1: Total Highway and Pedestrian Fatalities and the Percentage of Pedestrian Fatalities to Total Highway Fatalities, 2008 through 2018

Year	Pedestrian fatalities	Other	Total
2008	4414	33009	37423
2009	4109	29774	33883
2010	4302	28697	32999
2011	4457	28022	32479
2012	4818	28964	33782
2013	4779	28114	32893
2014	4910	27834	32744
2015	5494	29990	35484
2016	6080	31726	37806
2017	6075	31398	37473
2018	6283	30277	36560

Accessible Data for Figure 6: Percentage of Pedestrian Fatalities by the Age of Vehicle That Struck the Pedestrian, 2008 through 2018

Year	10 years old or newer	11 years old or older	Unknown or not reported
2008	63.4	25.8	10.8
2009	63.1	27.2	9.7
2010	58.3	32.2	9.5
2011	57.6	32.8	9.6
2012	55.6	35.4	9
2013	54.5	35.5	10
2014	52.4	38.3	9.3
2015	50.8	38.7	10.5
2016	48.9	40.4	10.6
2017	48.7	40.9	10.4
2018	48.4	40.4	11.2

Accessible Data for Figure 7: Number of Pedestrian Fatalities by the Reported Speed of Vehicle That Struck the Pedestrian, 2008 through 2018

Vehicle Speed	Stopped to 30 MPH	31 or more miles per hour (MPH)
2008	371	1315
2009	355	1362
2010	376	1467
2011	387	1523
2012	372	1485
2013	372	1346
2014	395	1501
2015	364	1562
2016	437	1626
2017	453	1688
2018	473	1912

Accessible Data for Figure 8: Model Year 2019 Vehicles Offering Pedestrian Automatic Emergency Braking or Crash Mitigation Features, as Reported by 13 Automakers

Pedestrian Automatic Emergency Braking	Percentage	Number of models
Not offered	40	105
Standard	37	96
Optional	23	61

Crash mitigation	Percentage	Number of models
Not offered	38	99
Standard	62	163

Accessible Data for Figure 9: Model Year 2019 Vehicles Offering Combinations of Pedestrian Automatic Emergency Braking (PAEB) and Crash Mitigation Features, as Reported by 13 Automakers

Equipment	Percentage	Number
Vehicles with PAEB and crash mitigation (out of 262)	47	122
Vehicles with PAEB but without crash mitigation	13	35
Vehicles without PAEB but with crash mitigation	16	41
Vehicles without PAEB but and without crash mitigation	24	64

Accessible Data for Figure 11: Number of Pedestrian Fatalities by Light Condition, 2008 though 2018

Year	Daylight	Dark	Dawn or dusk
2008	1145	3059	189
2009	1079	2846	162
2010	1092	3030	161
2011	1068	3204	162
2012	1168	3452	177
2013	1166	3405	181
2014	1191	3510	185
2015	1245	4040	188
2016	1311	4543	205
2017	1297	4522	235
2018	1256	4746	228

Accessible Data for Figure 12: Number of Pedestrian Fatalities by Relation to Intersection, 2008 through 2018

Relation to intersection	Intersection and Intersection Related	Non-Junction and Other
2008	1061	3346
2009	1132	2967
2010	1132	3156

Relation to intersection	Intersection and Intersection Related	Non-Junction and Other
2011	1155	3292
2012	1292	3519
2013	1246	3517
2014	1316	3578
2015	1461	4017
2016	1602	4463
2017	1635	4426
2018	1600	4638

Figure 13: Number of Pedestrian Fatalities by Body Type of Vehicle That Struck the Pedestrian, 2008 through 2018

Vehicle body type	Passenger Cars	SUVs	Light Trucks & Vans	Large/Medium Trucks/Buses	Motorcycles and Other/Unknown Vehicles
2008	1800	729	1075	350	460
2009	1693	683	1066	292	375
2010	1757	740	1083	317	405
2011	1859	752	1072	370	404
2012	2090	815	1140	360	413
2013	1962	811	1161	381	464
2014	2055	850	1227	361	417
2015	2383	955	1252	379	525
2016	2573	1149	1400	382	576
2017	2557	1223	1331	400	564
2018	2651	1222	1346	452	612

Accessible Data for Figure 14: Estimated Number of Pedestrians Injured in the United States, 2008 through 2018

Year	Upper bound of 95% confidence interval	Estimate	Lower bound of 95% confidence interval
2008	80300	71000	61800
2009	70900	61100	51200
2010	80300	72300	64200

Year	Upper bound of 95% confidence interval	Estimate	Lower bound of 95% confidence interval
2011	79700	71400	63100
2012	87900	78000	68100
2013	80200	69200	58300
2014	78800	68300	57900
2015	82000	72600	63200
2016	115000	92800	70700
2017	88800	76300	63800
2018	93900	79800	65700

Accessible Data for Figure 15: Estimated Number of Pedestrians Injured by Age of Vehicle That Struck the Pedestrian, 2008 through 2018

Year	Upper bound of 95% confidence interval for new to 10 years	10 years old or newer estimate	Lower bound for new to 10 years	Upper bound for 11 or more years	11 years old or older estimate	Lower bound for 11 or more years
2008	50900	44500	38100	19700	16300	12900
2009	44300	38000	31800	14700	12400	10100
2010	47500	42400	37300	19900	16400	13000
2011	45800	40300	34800	25000	21200	17300
2012	51100	43800	36600	28700	24000	19300
2013	44900	37600	30300	28100	22900	17700
2014	40800	35300	29800	27000	22400	17800
2015	46900	40600	34400	25200	21400	17500
2016	59600	47900	36200	35800	30000	24300
2017	49000	41000	33000	27300	24100	20900
2018	49900	41500	33100	29800	26100	22400

Accessible Data for Figure 16: Estimated Number of Pedestrians Injured by Body Type of Vehicle That Struck the Pedestrian, 2008 through 2018

Year	Upper bound of 95% confidence interval for passenger cars	Passenger cars estimate	Lower bound for passenger cars	Upper bound for Light trucks, SUVs and vans	Light trucks, SUVs and vans estimate	Lower bound for Light trucks, SUVs and vans
2008	45400	39500	33500	34700	29100	23600
2009	40500	34000	27500	29700	24800	19900
2010	46700	41600	36500	33000	28300	23600
2011	50200	43500	36800	28400	25200	22100
2012	53900	46200	38500	33300	28700	24100
2013	46800	38100	29500	32600	28300	23900
2014	45100	38300	31600	31900	27200	22400
2015	48800	42700	36600	31900	27200	22500
2016	69600	54800	39900	42000	35100	28200
2017	51800	43700	35500	33800	29300	24800
2018	52900	43700	34500	36700	32200	27600

Accessible Data for Figure 17: Estimated Number of Pedestrians Injured by Reported Speed of the Vehicle That Struck the Pedestrian, 2008 through 2018

Year	Upper bound of 95% confidence interval for 0-30 MPH	0-30 MPH Estimated	Lower bound for 0-30 MPH	Upper bound for 31 or more MPH	31 or more MPH estimate	Lower bound for 31 or more MPH
2008	20200	14700	9200	6400	4400	2400
2009	18900	13300	7700	5500	3900	2300
2010	21300	15400	9500	6900	4500	2100
2011	18500	12700	7000	6900	4600	2200
2012	19000	13700	8400	7300	5200	3100
2013	21800	14800	7800	5700	3900	2000
2014	19100	13100	7100	7800	5600	3300
2015	21300	15100	8800	6800	4800	2800
2016	21100	16700	12400	7300	5700	4100
2017	16900	13300	9600	6800	5200	3600
2018	23400	18400	13500	9900	8000	6100

Accessible Data for Figure 18: Estimated Number of Pedestrians with Suspected Serious or Fatal Injuries, 2008 through 2018

Year	Upper bound of 95% confidence interval	Estimate	Lower bound of 95% confidence interval
2008	18900	16200	13500
2009	19000	16200	13400
2010	17100	14700	12300
2011	17300	15100	12900
2012	20900	18100	15300
2013	19400	16500	13600
2014	18800	15700	12700
2015	19900	17000	14000
2016	28700	22600	16400
2017	21400	18800	16100
2018	21700	19100	16500

Agency Comment Letter

Accessible Text for Appendix IV Comments from the U.S. Department of Transportation

Page 1

April 6, 2020

Andrew Von Ah

Director, Physical Infrastructure Issues

U.S. Government Accountability Office (GAO)

441 G Street NW

Washington, DC 20548

Dear Mr. Von Ah:

The National Highway Traffic Safety Administration (NHTSA) leverages its available tools to improve the safety of vulnerable road users, including pedestrians. This year, in addition to the Crash Injury Research (CIREN) pedestrian study, NHTSA initiated a special study to gather detailed data on a selection of fatal pedestrian crashes. NHTSA is continuing its research on pedestrian crash test procedures by conducting tests with advanced legforms equipped with an upper body mass component, as well as evaluating test protocols that build on the global technical regulation tests that are in use or under development internationally. NHTSA is also evaluating nighttime performance of Pedestrian Automatic Emergency Braking systems and the feasibility and benefits of integrated passive and active pedestrian safety countermeasures. In addition, on October 16, 2019, NHTSA announced its plan to propose major updates to the New Car Assessment Program (NCAP) that are anticipated to include, for example, considerations for technologies to increase the safety of pedestrians.

NHTSA has the following actions underway to further improve NCAP:

- Exploring the readiness and development of advanced driver assistance technologies, including those for pedestrians, for consideration in NCAP.

- Developing a detailed proposal on next steps for NCAP that is anticipated to include pedestrian safety. NHTSA plans to publish the proposal in the Federal Register and seek public comment later this year.

Upon review of the GAO's draft report, NHTSA concurs with Recommendations 1, 2 and 3. Regarding Recommendation 2 to "document the overall process for making changes to NCAP, including established criteria and milestones for decisions, and share this process with external stakeholders," NHTSA notes that it has made the procedures used to change NCAP transparent and inclusive of the public. The agency has published its proposals for upgrading NCAP in the Federal Register, requested public comment on the proposals, and carefully considered all comments.[1] To further engage external stakeholders, NHTSA has held public meetings on some

[1] NHTSA, Request for Comment, NCAP, 80 FR 4630 (Jan. 28, 2015) (proposing to add automatic emergency braking (AEB) to NCAP); and NHTSA, Final Decision, NCAP, 80 FR 69604 (Nov. 5, 2015) (announcing the agency's final decision to add AEB to NCAP).

proposals. As an added measure, NHTSA agrees that documenting the overall process on the agency's website will generate more public awareness of this important consumer safety tool. We will provide a detailed response to each recommendation within 180 days of the final report's issuance.

Please contact Madeline M. Chulumovich, Director, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if you would like to obtain additional details.

Sincerely,

Keith Washington

Deputy Assistant Secretary for Administration

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